NUCLEAR SCIENCE ABSTRACTS

Volume 15 Number 15

Abstracts 19075–20475

August 15, 1961

UNITED STATES ATOMIC ENERGY COMMISSION
Office of Technical Information

USAEC DEPOSITORY LIBRARIES

Collections of USAEC reports are maintained in the libraries of the organizations listed below for reference use by the general public. Facilities for making photocopies are available. The USAEC also makes available through these libraries atomic energy reports of countries other than the U. S. that are abstracted in *Nuclear Science Abstracts*.

ALABAMA
Auburn, Auburn University
Birmingham, Public Library

ARIZONA
Tucson, University of Arizona

ARKANSAS
Fayetteville, University of Arkansas

CALIFORNIA
Berkeley, University of California
Los Angeles, University of California
Menlo Park, Stanford Research Institute
San Diego, Public Library

COLORADO
Denver, Public Library

CONNECTICUT
New Haven, Yale University

DELAWARE
Newark, University of Delaware

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Coral Gables, University of Miami
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

ILLINOIS
Chicago, John Crerar Library
Chicago, University of Chicago
Evanston, Northwestern University
Urbana, University of Illinois

INDIANA
Indianapolis, Public Library
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky
Louisville, University of Louisville

LOUISIANA
Baton Rouge, Louisiana State University
New Orleans, Tulane University

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Harvard University
Cambridge, Massachusetts Institute of Technology

MICHIGAN
Ann Arbor, University of Michigan
Detroit, Public Library

MINNESOTA
Minneapolis, University of Minnesota

MISSOURI
Kansas City, Linda Hall Library
Rolla, University of Missouri School of Mines and Metallurgy
St. Louis, Washington University

MONTANA
Bozeman, Montana State College

NEVADA
Reno, University of Nevada

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Buffalo, University of Buffalo
Ithaca, Cornell University
New York, Atomic Industrial Forum, Inc.
New York, Columbia University
New York, Public Library
Rochester, University of Rochester
Schenectady, Union College
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Charlotte, Charlotte and Mecklenburg County Public Library
Durham, Duke University
Raleigh, North Carolina State College

OHIO
Cincinnati, University of Cincinnati
Cleveland, Public Library
Columbus, Ohio State University
Toledo, University of Toledo
Youngstown, Youngstown University

OKLAHOMA
Stillwater, Oklahoma State University

OREGON
Corvallis, Oregon State College
Portland, Reed College

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
Rio Piedras, University of Puerto Rico

RHODE ISLAND
Providence, Brown University

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee
Memphis, Public Library
Nashville, Joint University Libraries

TEXAS
Austin, University of Texas
College Station, Agricultural and Mechanical College of Texas
Dallas, Southern Methodist University
Houston, Rice Institute
San Antonio, Public Library

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin
Milwaukee, Public Library

WYOMING
Laramie, University of Wyoming

Volume 15, Number 15 August 15, 1961

NUCLEAR SCIENCE ABSTRACTS

A SEMIMONTHLY PUBLICATION OF THE OFFICE OF TECHNICAL INFORMATION, U. S. ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts is the only comprehensive abstracting and indexing service devoted solely to the literature of nuclear science and technology. Published twice each month since 1947, *NSA* provides coverage of (1) technical reports of the United States Atomic Energy Commission and its contractors; (2) technical reports of government agencies, universities, and industrial and independent research organizations in the United States and abroad, and (3) the book, patent, and journal literature, and translations thereof, on a world-wide basis.

INDEXES

Regular Issues. Each issue of *NSA* includes subject, personal and corporate author, and report number indexes. Report numbers are also indicated in the author and subject indexes. The author indexes include "short titles" of the items indexed. The Report Number Index provides information on the availability of the reports.

Cumulations. The indexes included in the individual issues are cumulated quarterly, semiannually, and annually.* A cumulated report number, author, and subject index covering Vols. 1 through 4 (July 1948–1950) is included in the bound Vol. 4 which is available from the Johnson Reprint Corporation, 111 Fifth Ave., New York, N. Y. ($30.00). A subject and author index covering Vols. 5 through 10 (1951–1956) is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. ($5.25).

A cumulated report number index is issued annually as report TID-4000, *Public Availability of Reports Abstracted in Nuclear Science Abstracts*. This report is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. ($5.00).

HOW TO OBTAIN NSA

Subscription. The semimonthly abstract issues and the four cumulated-index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at the prices indicated below:

- *Semimonthly issues.* Annual subscription rate: $18.00, domestic; $22.50, foreign. Price per single copy: $1.25, domestic; 25 per cent extra for foreign mailing.
- *Cumulated-index issues.* Annual subscription rate: $15.00, domestic; $17.50, foreign. Price per single copy varies according to the number of pages.*
- *Domestic subscription rates* apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.
- *Foreign subscription rates* apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Exchange. *NSA* is also available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Technical Information Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

Availability to Government Agencies. *NSA* is available free of charge to all U. S. Government Agencies upon request to the Office of Technical Information Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

*A five-year index cumulation for Volumes 11–15 will be issued early in 1962. Therefore, for the current Volume 15, there will be no annual index. A fourth-quarter index will be issued instead to complete the volume. The price of the Volume 11–15 index cumulation and information concerning the price adjustment for Volume 15 indexes will be announced later.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

All U. S. Atomic Energy Commission reports are publicly available as indicated in the Report Number Index. Many reports of other government agencies and organizations, both in the United States and abroad, are publicly available. This information is included when known in the Report Number Index. Journal articles, books, and other published materials are available through standard commercial subscriptions or library sources.

Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

TABLE OF CONTENTS

Volume 15, Number 15, August 15, 1961

Volume 15, Number 15 August 15, 1961

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

19075 (AFOSR-416) TECHNICAL FINAL REPORT. PART I. NUCLEAR QUADRUPOLE RESONANCE IN IRRADIATED CRYSTALS AND IN A SEMI-CONDUCTOR. Jules Duquesne, M. Read, and J. Depireux. PART II. ORIGIN OF FREE RADICALS IN CARBONACEOUS ROCKS. Jules Duquesne and J. Depireux (Liege. Universite. Institut d'Astrophysique). Jan. 15, 1961. Contract AF61(052)-167. 49p.

I. The intensity decrease of quadrupole lines is used as a method for the study of damage induced by high-energy radiation in solid matter. Besides gamma rays, x rays and neutrons were also used. The method is successfully applied to a semiconductor and, by the study of $AsBr_3$, the results were shown to be independent of the nucleus, the line of which is chosen for the measurement. Some deviations from the general law describing the radiation resistance are reported in the class of iodinated compounds. Thermally treated irradiated compounds, which are thereafter reirradiated, are especially considered and, in this connection, the origin of radioprotection phenomena and the behavior of the interactions between centers perturbed by irradiation are studied. A generalization is proposed for the method by substituting the study of solid solutions for that of pure compounds, thus allowing the determination of radioresistance of any compound inclusive of the polymers.

II. The problem of the genesis of free radicals encountered in coals, lignites, peats, and petroleum is analyzed. Two hypotheses concerned with the botanical origin and the effect of natural radioactivity are presented. Whereas the former gives account of the facts for peats, the latter, combined with the geothermal hypothesis, allows a general solution for the problem. (auth)

19076 (BMI-1509(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1961. Contract W-7405-eng-92. 97p.

Preparation of a gamma U_3O_8 single crystal for x ray examination is reported. Data from developmental work on binary Nb alloys are presented on stresses to produce deformation rates of 0.001, 0.01, and 0.1% per hr at 650, 800, and 1000°C. Developmental work on miniature heating elements for use in a power-balancing thermal-neutron flux sensor is reported for imbedded wire and film-conductance elements. In development of Th–U alloys, chemical analysis data obtained from skull-cast samples are given. Results of a 1-month test on corrosion of Th-base compounds by NaK at 1200°F are tabulated. Data are given on mechanical and structural properties of Pu alloys being developed for high-temperature propulsion uses. Continued studies of PuO_2 compatability with various stainless steels are reported. Efforts were devoted to characterizing sintered UO_2 bodies by quantitative metallography. Techniques were developed for fabrication of cermet fuels containing 80 vol. % UO_2 and the remainder metals such as Cr, Mo, Nb or stainless steel. Fabrication studies on UN and UC fuels were conducted along with studies of gas pressure bonding methods. In development of UC, data on U–C systems at 1000 to 1500°C were obtained. Tests to determine the interdiffusion rates for C and U were completed. Irradiation of a capsule containing U–5 wt.% C was completed, and data are included. Experimental runs using the process-model system to study Mn removal from filtrates were completed. In graft polymerization studies, the effect of polymer structure on the efficiency of free-radical site formation was continued. In the joint U. S.-Euratom program, studies concerned obtaining information on void content and heat-transfer relations in forced-convection, two-phase flow, light-water systems. Development of UN as a fuel element is also in progress. Research is being conducted at HAPO on reactor materials in NPR and on operation of PRTR. Creep properties of Zircaloy-2 are being studied and radiation effects on thermal and electric properties of UO_2 are being examined. In a program to evaluate various coated-particle fuels, fission product retention as a function of burnup and operating temperature is being measured. The program is also aimed at optimization of the most promising coating materials and their reactions in radiation environments and gas coolants. In a study of spent fuel recovery, corrosion of process vessels and equipment from service in ORNL Fluoride-Volatility Pilot Plant is being evaluated. Evaluation of fueled-graphite spheres from 3 vendors for use in the Pebble Bed Reactor program are reported. Direct joining and transition joining of Zircaloy-2 to type 410 stainless steel are being investigated. The program also includes end capping Zircaloy-2 fuel sheaths by friction techniques. Radiation studies of SM-2 fuels are reported and fabrication methods for ML-1 fuels are described. Corrosion of Th and U and their alloys is being studied. Included are research and development on application of electroplated coatings. Techniques for Be cladding of UO_2 fuel elements are being developed; data on two specimens are included. (J.R.D.)

19077 (BNL-618) NUCLEAR ENGINEERING DEPARTMENT PROGRESS REPORT, JANUARY 1–APRIL 30, 1960. (Brookhaven National Lab., Upton, N. Y.). Feb. 1961. 94p. (BNL-S-55)

Reactor Physics. Oxide critical experiments were carried out on 5 volume ratios and exponential measurements

made on 4 volume ratios of 0.5-in. diam. stainless steel-clad 3% enriched uranium oxide rods in a water lattice. The fast effect was also measured and the buckling calculated. Data on GBF graphite were analyzed to give neutron diffusion constants and cross sections. Measurements of anisotropic neutron diffusion in graphite are reported. Studies of the behavior of the neutron activation cross section of Dy^{164} show that it falls off more rapidly in the region 0.1 to 2.0 ev neutron energy than a 1/v function. The power distribution in the Brookhaven Beam Research Reactor critical assembly was determined. Chemistry and Chemical Engineering. Apparatus and methods for preparing aromatic fluorocarbons are described. Preliminary results obtained for CoF_3 and F_2 as fluorinating agents in fluidized beds are described. Stable solutions of UCl_3 in molten $MgCl_2$–NaCl–KCl eutectic were prepared and their absorption spectra measured. Isotherms for the absorption of Xe on R-4 high-density graphite were determined at 750 and 1000°C, and the diffusivity of Xe in the same graphite was measured at 1000°C. The diffusion of Xe through 2S Al, 304 stainless steel, and Piqua fuel element cladding of thicknesses on the order of 0.02 to 0.03 in. at various high temperatures was studied; the results indicate that diffusion is negligible. The adsorption of Xe on activated charcoal from He streams was determined for He flow rates of 97 to 2000 cc/min and varying Xe pressures at 23°C. A W-Re thermocouple was calibrated in a furnace up to 1900°C and the results compared with optical pyrometer readings; the agreement with Lachman's data is good. A stability test was run in which the thermocouple was held in contact with graphite at temperatures above 1800°C for 180 hr; a significant change in the emf occurred with time. Removal of Xe from U–Bi fuel was investigated with a tower packed with stainless steel balls and a Bi–He countercurrent flow. A decrease in the Xe concentration by a factor of 6 was observed which is very close to decreases measured in perforated plate towers. NO_2–HF solutions were found to attack UC in graphite. Changes in volume and weight of ThO_2 and ThF_4 powders after contacting with NO_2–HF were observed. The heat of reaction of Zircaloy-2 and Zr with 25 mole% NO_2–75 mole% HF was determined to be 260 kcal/mole. Freezing points of NO_2–HF solutions were determined for the concentration range of 6 to 60 mole% NO_2; results were obtained indicating a slow reaction. A NO_2–HF solution was irradiated to a total dosage of 6.8×10^8 rad over 4 months, and pressure vs time readings were made. The infrared absorption spectrum of the vapor phase was measured after irradiation; the strong NO_2 bands were replaced by weak N_2O bands. In studies of corrosion by NO_2–HF during Zircaloy-2 dissolution, Monel remained unchanged in weight, whereas an Inconel thermocouple corroded. However, Monel, Inconel, and Ni in partial contact with each other was found to be subject to galvanic corrosion. The dissolution of Pu in the dissolution of U containing 560 ppm Pu by NO_2–HF was found to be 95 to 97% complete and to be unaffected by the presence of Zircaloy-2. The dissolution rates of BNL and Hanford grades of U were determined for the solvents BrF_3–HF, Br_2–BrF_3, and liquid Br_2. Dissolution of U, Th, and Zircaloy-2 in Br_2–$AlBr_3$, PBr_5, $POCl_3$, $SOCl_2$, and other nonaqueous inorganic solvents was also studied. The solubilities of UF_4 and ThF_4 in liquid NbF_5 were determined; after filtration of the solutions, the Tyndall effect was observed in the filtrates. Graphite immersed for 2 to 4 hr in NbF_5 was found to gain in weight. The use of fluidized beds to control the exothermic reactions involved in volatilization reprocessing of spent fuels was investigated by using alundum beds in the hydrochlorination of Zircaloy-clad subassemblies. UC oxidation and UO_2 fluorination in fluidized alundum beds were also studied. Studies of modified Zirflex and Niflex solvent processes for reprocessing Naval reactor core fuels are reported. A single extractant was developed for the simultaneous removal of Cs^{137}, Sr^{90}, rare earths, and transuranics from radiochemical waste solutions; simultaneous extraction coefficients were determined to be 1.5 for Cs^{137} and Sr^{90} and ~15 for the rare earths. Production of tetravalent U salts by photolytic reduction and chemical reduction with amines was studied. Gamma irradiation of aqueous NH_3 solutions in bombs gave a maximum $G_{N_2H_4}$ value of ~0.3 in the range of 60 to 70% NH_3. Radiation studies on solid state polymerization, graft copolymers, ionic polymerization, and aromatics are described. An equation was established for the attenuation of Co^{60} gamma radiation in two-segment ducts in concrete shields. Studies of dose distributions in finite paraffin targets from Cs^{137} sources were made. Denitration of Purex wastes by formaldehyde was found to have no bad effects on subsequent adsorption of Sr on clinoptilolite columns. The effect of citric acid on adsorption of Cs and Sr from waste solutions was also studied. Adsorption of Sr and Cs on H^+, NH_4^+, and Ca^{2+} forms of clinoptilolite and at low pH was determined. The preparation and leaching of glasses produced by mixing clinoptilolite with Purex wastes are described. Heat transfer coefficients for turbulent flow of liquid metals in annuli are derived for constant heat flux through the inner wall only and compared with earlier work. Hot Laboratory. A production model of a Y^{90} generator is described. The method for assaying Sr^{90} contamination was changed to use the bicarbonate form in place of the hydroxyl form of Dowex 1 resin. Various methods of preparing Ca^{47} were considered, including Szilard-Chalmers reactions, spallation, pre-enrichment of Ca^{46}, and $Ti^{50}(n,\alpha)Ca^{47}$ reaction. The excitation function for $Ti^{50}(n,\alpha)$ was calculated to have a maximum between 4 and 8 mb at a neutron energy of 17.5 ± 2.0 Mev. Several ways of chemically separating Ca from Ti are described. Methods of producing Sc^{47}, Ar^{38}, Cu^{67}, I^{124}, Sm^{151}, I^{132}, and a small alpha needle with Po^{210} mounted on its end are discussed. Fluorimetric methods for determining U in Na and fuel elements are outlined. Apparent discrepancies in analyses of $(Te\text{-}I)^{132}$ product solutions were resolved as due to hydrolytic precipitation of Te at nearly neutral pH. Improvement of methods for Mn determination in blood is discussed. Analysis of Zircaloy fuel element solutions for F^- is feasible using flame photometry and the Ca-F molecular emission band at 529 mμ. Since 2 M HCl was found not to strip Th from a xylene solution containing 0.5 M triiooctylamine (R_3N) and 0.5 M thenoyltrifluoroacetone (HT), the possible reaction between the Th–HT complex and R_3N was investigated and found to be $4HT + Th^{4+} + R_3NHCl \rightarrow R_3NHCl \cdot ThT_4 + 4H^+$. The reaction of tri-n-octylamine with acid was also studied and the equilibrium constant for $R_3N + H^+ + Cl^- \rightleftharpoons R_3NHCl$ determined to be $1.2 \pm 0.2 \times 10^4$. Ti can be determined in Pb–Bi alloys by precipitating the cupferronate of Ti in presence of EDTA, extracting it with methyl isobutyl ketone, and measuring its absorption at 350 mμ. The chronopotentiometric behavior of metal ions in fused LiCl–KCl eutectic was studied for Pt, Cd, and Bi. The operations of the Waste Concentration Plant are summarized. Metallurgy. The results of examination of steel loops run with Bi, U–Bi, and Bi–Pb eutectic are presented. Studies of Bi as a bearing lubricant for Stellite hard-faced on carbon steel indicate that Bi is a good lubricant and that pre-wetting improves the lubrication. Mechanisms for nitrogen removal from steel by surface reaction with liquid Bi–Zr at 751°C are discussed. Rates of formation of ZrN and ZrC films on

steels immersed in liquid Bi–Zr were measured at 751°C; the results suggest a spalling of the initially formed film in the first few hours followed by diffusion-controlled film growth. The effects of in-pile conditions on the corrosion resistance of pure Mo and Ta in static Zr-Mg-inhibited U–Bi were studied; Mo was severely attacked, while Ta did not corrode. The size and shape of specimens appear to have no effect on the oxidation rate of graphite. The effects of ultrasonic cleaning in CH_3OH and CH_3OH soaking on graphite oxidation are described. Some results of investigations of impurity distribution in graphite blocks are given. Graphite in-pile samples from the BNL Reactor were measured prior to and after the 13th anneal for comparison with previous growth and recovery. Studies of graphite burning by air were conducted in 10-ft long channels of 1-, 2-, and 2.63-in. diameters which indicated that runaway or equilibrium conditions cannot be attained in the turbulent flow region below 675°C. Small temperature rises are possible with laminar gas flow. Some of the differences between turbulent and laminar flow results are discussed. The maximum initial heating rates and temperature accelerations were found to depend on the CO-O_2 reaction more than on the C-O reaction. Equilibrium conditions for one channel diameter can be predicted from data for another diameter if the ratio of turbulent heat transfer coefficients is known. The birefringence regions in single crystals of synthetic sapphire were found to be caused by very thin lamellar twins on the $(10\bar{1}2)$ planes. Corrosion studies of 309 ELC and 309 SCb stainless steel by HNO_3 and HNO_3–HF solutions are reported. The effects of chloride ion on aqueous corrosion pits on pure Fe surfaces were studied, and the pit size was found to be related to grain orientation. Fission tracks were obtained in mica containing U^{235}, and natural and synthetic mica were irradiated to total exposures of 6×10^{17} nvt; the irradiated synthetic mica was found to contain a large number of collapsed vacancies or loops. The effects of quenching, annealing, and irradiation on thin Al foils were studied by transmission microscopy. The Mark I fuel element prototype for the BBRR was rejected because of U segregation in the 30% U–Al plates. Micrographs and radiographs of Mark I and VI fuel plates are presented. A new ETR test element consisting of 30 wt.% U in 1100 Al + 3% Si and clad with X-8001 Al is specified. Studies of Th–Bi slurries were made in which deposits formed in cool loop sections were analyzed carefully to determine the mechanisms of their formation and in which the effects of Te additions were investigated. ThO_2–Bi slurries were also studied; the items studied include the following: (1) receding contact angles between liquid Bi alloys and cleavage surfaces of ThO_2, (2) wetting of ThO_2 by Bi containing Mg or Zr, (3) inhibition of wetting by Co and CO_2, (4) filtration of slurries, and (5) dewetting. Results of the slurry studies are discussed in detail. A research program is described for studying a fuel element consisting of a fuel alloy, which is partially molten under reactor conditions, sealed in a graphite container. Preliminary temperature differential studies are reported for encapsulated U–Bi and Th–Bi alloys. Mechanical Engineering. The current status of the Brookhaven Beam Research Reactor is summarized. Other projects, including heat transfer loops, critical assemblies, and chemonuclear reactors, are discussed. (D.L.C.)

19078 (CIT-AF8A-TR32) STATISTICS OF PARTICLE MEASUREMENT AND OF PARTICLE GROWTH. R. J. Duffin, R. A. Meussner, and F. N. Rhines (Carnegie Inst. of Tech., Pittsburgh). Apr. 1, 1953. Contract AF33(616)-294. 19p.

The size distribution of round particles as determined by linear or planar sectioning is related to the true distribution by certain integral equations, for which solutions are included. General properties of distribution functions of particles having continuous growth are analyzed. The theory proposed correlates some observed behavior of silicon particles in Al-Si systems. (auth)

19079 (MLM-1108) MOUND LABORATORY PROGRESS REPORT FOR DECEMBER 1960. (Mound Lab., Miamisburg, Ohio). Dec. 30, 1961. Contract AT(33-1)-GEN-53. 16p.

Activities are reported in a program to investigate formulations and procedures which may lead to superior plastics and adhesives. In other work, processes for separating and purifying radioelements are being developed and supply sources are being evaluated. Research was initiated to determine the density, viscosity, thermal capacity, and thermal conductivity of Pu and Pu alloys for use in fast breeder reactors. (J.R.D.)

19080 (NASA-TN-D-843) RESIDUAL-LOAD-PLUS-POWERPLANT WEIGHTS FOR ORBITAL-LAUNCH NUCLEAR ROCKETS. Paul G. Johnson, James W. Miser, and Roger L. Smith (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1961. 26p.

Charts are presented of residual-load-plus-power-plant weight as a function of thrust, specific impulse, initial weight in orbit, and mission energy for orbital-launch nuclear rockets. The initial weights range from 7,600 to 226,000 pounds (corresponding to Atlas-Centaur, Saturn, and Nova boost vehicles), and missions are selected to cover the approximate capability inherent in the specified weights. Thrust is varied so that thrust-to-initial-weight ratio lies between 0.01 and 1.0, while specific impulse is varied from 450 to 1,000 pounds per pound per second. Values of residual-load-plus-power-plant weight are computed by estimating the required weights of hydrogen propellant, tank, and vehicle structure. (auth)

19081 (NAVORD-4153) OPERATION TEAPOT—UNDERGROUND SHOT BASE SURGE ANALYSIS. Interim Report No. 15. Mary L. Milligan and George A. Young (Naval Ordnance Lab., White Oak, Md.). Jan. 31, 1956. Decl. Apr. 28, 1959. 69p. (AFSWP-876)

The TEAPOT underground shot (ESS) was a 1.2 KT burst at 67 ft. The column diameter was 925 ft and the base surge traveled 2900 ft upwind, 8000 ft crosswind and over 3 mi downwind before losing its identity and merging with the other surface phenomena to form a continuous diffuse dust cloud. Radial throwout reached 2000 ft, the jet height was 8000 ft and the smoke crown diameter was 3800 ft. Comparisons are made with the JANGLE Underground Shot (1.2 KT at 17 ft) results and with high explosive data. A method is presented for predicting column diameter and surge lateral extent for nuclear bursts in similar soil. TEAPOT photographic and radiological instrumentation results indicate that exposed personnel engulfed by the base surge at early times would possibly have received a lethal dosage of gamma radiation. (auth)

19082 (NP-10177) DEVELOPMENT OF ION PROPELLANT SYSTEM. Quarterly Technical Progress Report No. 4, December 15, 1960 to March 15, 1961. Donald R. Snoke and P. J. Lawlor (Thompson Ramo Wooldridge Inc., Cleveland). Mar. 24, 1961. Contract AF33(616)-7219. 26p. (ER-4388)

Discussions are given of the completion of tests conducted on a final pump and vaporizer combination and of assembly and fabrication of a prototype system for en-

durance testing. Compatibility problems uncovered by the pump-and-vaporizer tests are described. All components incorporated in the prototype proved reliable when tested in expected operating conditions. (B.O.G.)

19083 (NYO-9374) STRUCTURAL ANALYSIS AND DESIGN CONSIDERATIONS FOR SHIPPING CONTAINERS OF HIGHLY RADIOACTIVE MATERIALS. Robert G. Sanford (Johns Hopkins Univ., Baltimore). May 1961. Contract AT(30-1)-1477. 78p.

An analysis is made of the static forces necessary to cause serious damage to containers used in the shipment of irradiated fuel elements and fission product solutions, three of the former and one of the latter. The fuel element casks are inherently massive because of the thickness of their lead shielding walls (10.5 to 12.0 inches). When the outer and inner cylindrical steel shells are also considered, the resistance to wall collapse, although not accurately computed, is estimated to be very high indeed, much higher than that of the thinner walled solution tank mentioned in the next paragraph. Because of these facts and because no theoretical basis is available for analysis, attention was focussed instead on the much greater possibility of damage to closures and protruding fittings. In the case of the fission product solution cask the lead shielding wall is much thinner (3.5 inches), and for this reason not only is it more susceptible to failure but some theory is available as a basis of analysis. Some of the forces which might cause damage to the cask itself are computed. In addition to the evaluation of damaging forces a comparison is made of the relative advantages of using lead, iron, and uranium as shielding materials; a few ideas are presented which may be useful in new designs or in the modification of existing ones; and, finally, tie-down methods and practices are discussed. It was found that force levels where failure of the casks proper is incipient are high compared with the strength of closures and fittings, which are low enough to need protection, and the analysis problem is so complex and theory so wanting, particularly when dynamic conditions are confronted, that model or prototype tests are fully warranted. (auth)

19084 (SC-4574(RR)) HIGH EXPLOSIVE CRATER STUDIES: TUFF. Byron F. Murphey (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 31p.

Spherical charges of TNT, each weighing 256 pounds, were exploded at various depths in tuff to determine apparent crater dimensions in a soft rock. No craters were obtained for depths of burst equal to or greater than 13.3 feet. It was deduced that rock fragments were sufficiently large that charges of greater magnitude should be employed for crater experiments intended as models of nuclear explosions. (auth)

19085 (WADD-TR-60-895) XM-731 PLASMA ENGINE. Final Report. B. W. Harned, A. Sherman, G. L. Borman, G. E. Graham, and B. Podolsky (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Jan. 31, 1961. Contract AF33(616)-7176. 120p.

An experimental and theoretical program was conducted to investigate the performance of a crossed-field MHD accelerator under continuous flow operation for space propulsion purposes. Configuration studied is a divergent duct in which is applied a constant electric field across parallel electrodes and a magnetic field from an external magnet with tapered polepieces. The experimental work involved construction and test of several models, and design and operational information are described. Theoretical programs produced information on electrical conductivity of seeded gases, analysis of end and Hall effects in such a duct, and calculations of performance of typical engines in terms of specific impulse, and power and thrust levels. (auth)

19086 (WADD-TR-60-895(App.I)) THE ELECTRICAL CONDUCTIVITY OF SEEDED INERT GASES. A. Sherman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Appendix I of XM-731 PLASMA ENGINE. p.99-121.

A procedure is described for calculating the electric conductivity of a hot gaseous propellant for a continuous-flow magnetohydrodynamic plasma accelerator. Considerations are restricted to a gas mixture having one inert component and one readily ionizable seed gas. The inert gas should have a small electron-neutral collision cross-section and the seed gas should have the smallest possible ionization potential. Conductivities were calculated for Ar−Cs, Ar−Li, Ar−K, and He−Li mixtures as a function of seed percentage at 2500 to 3500°C, 0.1 to 1000 mm Hg, and magnetic field strengths of zero and 10^4 gauss. (B.O.G.)

19087 (WADD-TR-60-895(App.II)) SOME ASPECTS OF THE HALL EFFECT IN CROSSED FIELD MHD ACCELERATORS. Boris Podolsky (Cincinnati. Univ.) and A. Sherman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Appendix II of XM-731 PLASMA ENGINE. p.122-47.

A number of the problems arising because of the existence of the Hall effect in crossed-field MHD accelerators are considered. A qualitative discussion of the Hall phenomenon is given, based on the microscopic picture, and a suitable "generalized" Ohm's law is discussed. As a result of this effect, there is a considerable reduction in efficiency of a crossed-field MHD accelerator. An estimate of the reduction is obtained within the one dimensional approximation. It is concluded that for $\omega\tau \sim 1$, and for continuous electrodes, the Hall effect alone does not reduce efficiencies below acceptable values. It is shown that high efficiency devices are least susceptible to inefficiencies created by the Hall effect. The end currents which arise in finite length accelerators are investigated analytically, and a sample calculation is presented for $\omega\tau = 1$. It is pointed out that over and above the mathematical singularities which occur at the two electrode corners, in the end region, the Hall effect increases the current concentration at one electrode corner and reduces it at the other. (auth)

19088 (WADD-TR-60-895(App.III)) CALCULATION OF THE END AND HALL EFFECT WITH UNEQUAL ELECTRODES. Boris Podolsky (Cincinnati. Univ.) and A. Sherman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Appendix III of XM-731 PLASMA ENGINE. p.148-54.

An extension is given of a previous analysis of the non-uniform current distribution in an electrode caused by the Hall effect in the end region of a magnetohydrodynamic channel. The extension deals with a quantitative evaluation of the reduction in concentration caused by extending one electrode past the other thereby allowing the current a greater area through which to flow. (B.O.G.)

19089 (WADD-TR-60-895(App.IV)) THEORETICAL PERFORMANCE OF A CROSSED FIELD MHD ACCELERATOR. A. Sherman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Appendix IV of XM-731 PLASMA ENGINE. p.155-87.

A theoretical analysis of a crossed-field MHD plasma accelerator based on the radial-source flow model is presented in which any propellant, which is a mixture of seed and inert gas, can be treated, and allowance is made for the flow of Hall currents. Provision is made for investiga-

tion of both a shifting equilibrium and a frozen equilibrium expansion in the accelerator. Consideration is given to both permanent and electromagnet designs suitable for such application. Calculations were carried out for a number of potentially practical designs; the results are reported in terms of specific impulse, thrust, efficiency, and electrical power level. (auth)

19090 (WT-1152) ATOMIC CLOUD GROWTH STUDY. B. H. Grossman, L. Machta, L. R. Quenneville, S. W. Dossi, and J. Halsey (Air Force Cambridge Research Center, Mass.). Oct. 1955. Decl. Nov. 4, 1960. Project 9.4 of OPERATION TEAPOT. 138p.

An attempt was made to document the evolution of atomic clouds during the teapot series in order to define the rate of rise, maximum height, vertical depth of mushroom, dimensions of stem, and volume for a period up to 20 min. after burst when photographically feasible. The meteorological data were correlated with available cloud data on past Nevada test series as well as the Teapot series. Photographic and theodolite data were collected on 14 shots. Analysis of weather parameters affecting cloud heights attained did not suggest any clear-cut definitions with the exception of the tropopause dampening effect. Application of current theories was investigated and the results compared. (auth)

19091 PETROLEUM AND URANIUM AS POWER SOURCES. Jean LeChatelier (Compagnie de Construction Mécanique Procédés Sulzer [France]). Energie nucleaire (France), 3: 101-9(Mar.-Apr. 1961). (In French)

Uses of conventional and nuclear energy are compared. Future uses of nuclear power may include direct heat production, electricity production with high load factors, and ship propulsion. It is noted that petroleum and uranium uses in the future must be coordinated. (T.F.H.)

19092 NUCLEAR ENERGY AND OPERATIONAL RESEARCH. J. Gaussens (Commissariat à l'Energie Atomique, [Paris]). Energie nucleaire (France), 3: 110-16 (Mar.-Apr. 1961). (In French)

The potentialities of operational research in the solution of nuclear problems are outlined. Problems discussed include reactor structure and programming. Management economy, total cost, and long term aspects of nuclear energy programs are described. (T.F.H.)

19093 THE PART OF ELECTRONICS IN ATOMIC ENERGY. M. Doireau (Commissariat à l'Energie Atomique [France]). Energie nucleaire (France), 3: 117-27(Mar.-Apr. 1961). (In French)

Electronic instrumentation makes possible detection, measurement, analysis, and control of nuclear processes. The present and future roles of electronics in the field of atomic energy are described, and applications in nuclear research, particle accelerators, and reactors are detailed. (T.F.H.)

19094 NUCLEAR SAFETY. Technical Progress Review, Vol. 2, No. 3. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Mar. 1961. 78p.

Recent developments in nuclear safety are reviewed. Topics discussed include nuclear standards for safety, the biological basis for routine exposure criteria, an analysis of burnout in reactors, a summary description of the SPERT program, recent developments in nuclear process instrumentation and controls, the human element in safety instrumentation, recent developmental work on methods for detecting and locating burst fuel elements, the development of reactor fuses, the safety aspects of locating power reactors underground, the removal of radioiodine from reactor gases, safety procedures for radioisotope source fabrication, a review of the program for improving radiation safety at Oak Ridge National Laboratory, the toxic effects of Sr^{90}, the explosion which occurred in the SL-1 reactor, the organization and procedures of the AEC Division of Licensing and Regulation, and a summary of action on reactor projects by licensing and regulating bodies. (C.H.)

19095 NUCLEAR PROPULSION. M. W. Thring, ed. London, Butterworth & Co. (Publishers) Ltd., 1960. 303p. $9.50.

Aspects of nuclear marine, aircraft, and spacecraft propulsion are studied. Design, metallurgical, and heat transfer problems associated with propulsion systems reactor are discussed. Nuclear and reactor physics, jet and rocket propulsion thermodynamics, and medical and biological aspects of sealed environments are examined. Attention is devoted to the following: reactor control and instrumentation; uses of ceramics in reactors; problems encountered in handling working fluids; and uses of the nuclear closed-cycle gas turbine. (T.F.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

19096 (IEA-30) ALGUNS ASPECTOS DO PROBLEMA DA DETERMINACÃO DA VIDA MEDIA DE ERITROCITOS COM O EMPREGO DO Cr-51. I—PARTE. (Some Aspects of the Problem of the Determination of the Mean Life of Erythrocytes with the Use of Cr^{51}. Part I). R. R. Pieroni and V. Maspes (São Paulo. Brazil. Universidade. Instituto de Energia Atomica). 1959. 22p. (CNEN-IEA-4)

An examination was made of the analytical expressions which represent the number of labeled erythrocytes. Simplifying hypotheses were made so that the results should be regarded as a first approximation. (J.S.R.)

19097 (IEA-32) SOBREVIDA DOS ERITROCITOS DE SANGUES TRATADOS COM VIOLETA DE GENCIANA. (Survival of Erythrocytes in Blood Treated with Gentian Violet). Victorio Maspes, Romulo R. Pieroni, Oswaldo Mellone (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1959. 14p.

The survival of erythrocytes in blood treated for 24 hours with sufficient gentian violet to cure Tripanozoma Cruzi was determined in samples held at 4°C. The technique of Cr^{51}-labeling was used. An attempt was made to adjust various types of equations to the experimental data, and a simple exponential equation was found to fit best. This fact indicates that dye alters the erythrocytes independently of age. The alteration does not contraindicate the use of the dye. The values obtained for the survival varied from 62 to 93 days for the mean life. (tr-auth)

19098 (IEA-33) USO DO Cr-51 EM PESQUIZA CLINICA E EM PROPEDEUTICA. I—DETERMINACAO DA VOLEMIA E DA SOBREVIVENCIA DOS ERITROCITOS. (Use of Cr^{51} in Clinical Investigation and in Propedeutics. I. Determination of the Volume and Survival of Erythrocytes). Victorio Maspes, Romulo R. Peroni, and Clara R. Carelli (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 24p. (CNEN-IEA-7)

After a brief recapitulation of the applications of Cr^{51} in clinical investigations, its use in the determination of the globular volume and in the study of erythrocyte survival is examined. It is shown how a single dose of the tracer can be used to obtain the volume and survival. A procedure for calculating the mean life of the erythrocytes is adopted and justified. The problem of the variation of the volume is examined, and a method of compensating the resulting errors is suggested. (tr-auth)

19099 (IEA-35) METODOLOGIA Y APLICACIONES CLINICAS DE LOS RADIOISOTOPOS. (Methodology and Clinical Application of Radioisotopes). Romulo Ribeiro Pieroni (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). July 1959. 300p.

The course on clinical application of radioisotopes, given at the Universidad Nacional de Asuncion, Paraguay, is presented. As an introduction to the study of the clinical utilization, the constitution of matter, radioactivity, interaction between radiation and matter, counters, biological effects of radiation, and dosimetry are discussed. The use of radioisotopes is then considered in general and in vitro and in vivo measurements are described. The use of radioisotopes in hematology, in the functional study of the liver and kidney, in the study of circulatory problems, in the study of thyroid function, in oncological diagnostics, and in the study of the human body is presented. (J.S.R.)

19100 (WT-527) BIOMEDICAL EXPOSURE EQUIPMENT. R. H. Draeger, M. Eicher, T. S. Ely, F. T. Harris, R. H. Lee, T. E. Shea, and F. I. Whitten (Naval Medical Research Inst., Bethesda, Md.). Dec. 1952. Decl. Dec. 7, 1960. Project 4.2 of OPERATION SNAPPER. 81p.

Two methods of exposing animals to the direct effects of atomic bomb air blast were investigated. In the first, wooden dogs containing accelerometers were exposed in open mesh cages suspended above a protective barrier on swinging arms and slide wires. In the second method, peak pressure and pressure-time recorders were exposed in Operation Greenhouse animal exposure containers with open ends. Cylindrical exposure containers developed for Operation Greenhouse in connection with the study of total body irradiation of animals were modified to permit thermal radiation burns in swine. The animals were exposed behind multiple shutter-controlled aperatures to provide an intensity vs. time biological evaluation of thermal energy. Single-layered multiple compartment mouse cages, suitable for lethal dose type study were designed and evaluated for variation in dose with position in cage compartments by means of film and glass dosimeters. The instruments which were designed and tested for use with animal exposure equipment included photoelectric relay, air blast overpressure relay, ground shock relay, silicone timer, magnetic trip, motion picture camera, time delay relay, and battery power supply. (auth)

19101 (WT-531) THE TIME-COURSE OF THERMAL RADIATION AS MEASURED BY BURNS IN PIGS. Harry D. Kingsley, Paul R. Schloerb, Charles H. Murden, Jr., Dnaiel B. Williams, and Herman E. Pearse (Rochester, N. Y. Univ. Atomic Energy Project). Mar. 1953. Decl. Dec. 7, 1960. Project 4.6 of OPERATION SNAPPER. 49p.

Anesthetized young Chester White pigs were placed in protective containers and exposed to the thermal radiation from two atomic bomb explosions. Exposures were limited by aperture plates, each of which contained ten circular ports. Exposure times through these ports were varied by electrically operated shutters. Other containers were used to compare large (3 × 4.5-in.) and small (0.75-in.) area burns. Resultant burns were analyzed grossly and microscopically for degree of severity. The burn severity was related to the amount of energy producing the same degree in the laboratory and then compared to measured thermal energy from field data. The most severe burning occurred in the second 0.1 sec period. There was little increase in the severity of a burn after 0.5 sec. No significant burns were produced on normal skin after 0.6 sec, despite the presence of a relatively large amount of measured incident energy. Small burns through limiting apertures were of the same severity as large burns produced behind large apertures on the same animal. (auth)

19102 (JPRS-4601) EFFECTS OF IRRADIATED FOOD PRODUCTS ON THE REPRODUCTIVE FUNCTION OF RATS AND ON THEIR PROGENY. G. I. Bondarev. Translated from Voprosy Pitaniya, 19: No. 6, 18-22(1960). 6p.

The effects of a diet consisting of irradiated beef, codfish, green peas, rye bread, and oat groats on reproductive function and progeny of rats were studied. Results indicate that irradiation caused a decrease in nutritional value and vitamins in the foods. Sexual functions of the rats were decreased, and growth, development, and viability of the progeny were retarded. (C.H.)

19103 (UCRL-Trans-527) ON THE PROPERTY OF CHLOROPHYLL OF PHOTOSENSITIZING REDOX REACTIONS UNDER HETEROGENEOUS CONDITIONS. V. B. Evstigneev and V. A. Gavrilova. Translated from Biofisika, 4: 641-9(1959). 24p.

Results are reported from a series of studies on reaction mechanisms involved in photosynthesis. The ability of isolated chlorophyll to photosensitize redox reactions under heterogeneous conditions is discussed. Results are reported from studies on the ability of crystalline phthalocyanins to sensitize the photooxidation of ascorbic acid with oxygen, and on the presence of electron exchange on the surface of chlorophyll films under illumination. (C.H.)

19104 PROTEOLYSIS OF I^{131}-LABELLED GAMMA-GLOBULIN. V. Bocci (National Inst. for Medical Research, London). Intern. J. Appl. Radiation and Isotopes, 10: 94-8 (Apr. 1961). (In English)

The proportion of iodide in a papain digest of I^{131}-labelled denatured γ-globulin is negligible; after acid hydrolysis it is more than 85%. On the basis of this observation the measurement of TCA-soluble radioactivity as a procedure for estimating enzymic proteolysis of labelled globulins is justified. Using double labelling, the rates of digestion of native and altered γ-globulins are compared. (auth)

19105 A TOTAL-BODY IRRADIATOR. M. Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). Intern. J. Appl. Radiation and Isotopes, 10: 99-105(Apr. 1961). (In English)

A total-body irradiation room was built with eight cesium-137 sources. One 500-c source is near each corner of an 8 ft cubical room. An open maze, closed only with a gate, allows the patient and nurse to appear, through mirrors, to be in the same room. The patient is supported in the center of the $2 \times 2 \times 6$ ft irradiation volume on a rigid aluminum bed. The exposure rate to the patient can be changed from 280 to 1.8 r/hr. The exposure rate outside the room is less than 0.01 mr/hr. Clinical dosimetry is defined in terms of minutes. Physical dosimetry includes classical, chemical, and phantom studies. (auth)

19106 THE FORMATION OF DOSE FIELDS IN ROTATION GAMMATHERAPY. V. V. Dmokhovskii, I. I. Kornev, I. A. Peresiegin, and A. F. Rimman (State Scientific Research Inst. of Roentgen-Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 2, 57-64(Feb. 1961). (In Russian)

The elaborated method makes it possible to arrange dose fields for all rotation conditions, proceeding from the curve of radiation weakening during static irradiation. The method was employed for the formation of Co^{60} dose fields, however, it could be utilized either for roentgen therapy, or for superhigh voltage therapy (with the aid of betatrons, linear accelerators, etc.). It has been ascertained that the position of the maximum dose (Co^{60}) in the irradiated organism depends to a considerably lesser degree on the rotation conditions, in comparison with the employment of routine apparatus for deep roentgen therapy. (auth)

19107 ESTIMATION OF THE DOSE OF RADIOACTIVE GOLD (Au^{198}) FOR INTERSTITIAL ADMINISTRATION. V. A. Petrov (Central Scientific Research Inst. for Medical Radiology). Vestnik Rentgenol. i Radiol., 36: No. 1, 37-40 (Jan.-Feb. 1961). (In Russian)

Special tables are given for estimating the exposure dose in roentgen units and the absorption dose in rad units in the tumor after injection of colloidal gold (Au^{198}). The tables are elaborated on the basis that the Au^{198} concentration equals 1 millicurie/cm^3. If the concentration used in practice differs from the one pointed out in the table, the doses in the table should be changed correspondingly. The doses in the table are given for different sizes of the tumor (tumor radius) and various effective periods of half-life. The latter is determined experimentally. (auth)

19108 RADIOACTIVITY IN MAN. Whole Body Counting and Effects of Internal Gamma Ray-Emitting Radioisotopes. A Symposium held at the Vanderbilt University School of Medicine, [April 18-19, 1960]. George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961. 507p. $16.50.

Thirty-five papers are included; separate abstracts were prepared for 31. One paper was previously abstracted in NSA. Titles of the three papers not abstracted are: Informational Demands upon Political Leadership; Public Relations for Scientists; Public and Private Collaboration in Research. (D.E.B.)

19109 PRINCIPLES OF GAMMA RAY SCINTILLATION SPECTROSCOPY AND ITS USE FOR HUMAN WHOLE BODY COUNTING. G. J. Nijgh (California Inst. of Tech., Pasadena). p.5-15 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

It is pointed out that γ scintillation spectroscopy is not only useful in basic research, but allows diagnostic tracer experiments to be performed in humans at low levels of radiation exposure. (C.H.)

19110 THE USE OF LOW LEVEL GAMMA SCINTILLATION SPECTROMETRY IN THE MEASUREMENTS OF ACTIVITY IN HUMAN BEINGS. L. D. Marinelli, C. E. Miller, H. A. May, and J. E. Rose (Argonne National Lab., Ill.). p.16-30 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Developments in the design of low-level gamma scintillation spectrometers for use in measurements of activity in humans are outlined. Results are reported from many studies pursued to improve precision and to ascertain, eliminate, or reduce the sources of counter background, and to investigate the usefulness of coincidence techniques. It was concluded that the essential limitation of NaI counters is their unadaptibility to varied shapes and their high initial cost. For optimum efficiency under diverse contamination multiple crystals give best results and a variety of sizes are needed. The relatively high cost of gamma ray spectrometers has limited their use. (C.H.)

19111 SUPPLEMENT TO THE USE OF LOW LEVEL GAMMA SCINTILLATION SPECTROMETRY IN THE MEASUREMENTS OF ACTIVITY IN HUMAN BEINGS. L. D. Marinelli, C. E. Miller, H. A. May, and J. E. Rose (Argonne National Lab., Ill.). p.84-96 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The principal sources of background counts in low-level gamma scintillation spectrometry are considered, and methods available for reducing each component are discussed. (C.H.)

19112 THE WALTER REED WHOLE BODY COUNTING PROGRAM AND METHOD OF DATA PROCESSING. Kent T. Woodward (Walter Reed Army Medical Center, Washington, D. C.). p.117-28 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Procedures used for whole-body counting and data processing are described. The operation of a facility for determining γ activity directly in humans by means of a liquid scintillation detector is discussed. Methods of calibration for Cs and K determinations in man are described. It is pointed out that with care in selecting the method of calibration and data processing, a program can be worked out and

repetitous tasks in data processing can be minimized economically. (C.H.)

19113 SOME APPLICATIONS OF THE LOS ALAMOS HUMAN SPECTROMETER. M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.). p.219-30 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Applications of the Los Alamos human spectrometer in studies of radionuclide retention in human subjects and accidental exposures of personnel working in the atomic energy field are discussed. Applications in measurements of internally deposited Zn^{65}, I^{131}, I^{133}, I^{135}, and Np^{239} are described. A nuclear criticality accident during Pu processing in 1958 resulted in several mild and one fatal radiation exposure. Measurements of the Na^{24} content were made on all persons involved as an aid to calculating the neutron dose. Neutron activation of a tooth filling produced 47-day Hg^{203} and 253-day Ag^{110}. Fast neutrons also produced P^{32} in the hair by the $S^{32}(n,p)P^{32}$ reaction, which was easily measured by β counting techniques. Measurements were also made on an individual exposed accidentially during a tunnel shot in 1958 at the Nevada Test Site. Measurements showed the presence of about 0.1 μc of Cs^{137} and Ba^{140}/La^{140} Measurements of pure β emitters in people by external Bremsstrahlung counting are reported following the internal deposition of P^{32}, Sr^{89}, Sr^{90}, or Y^{90}. (C.H.)

19114 APPLICATIONS OF WHOLE BODY LIQUID SCINTILLATION COUNTERS. Wright H. Langham (Los Alamos Scientific Lab., N. Mex.). p.311-22 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Applications of liquid scintillation whole-body γ detectors over a six-year period are reviewed. The counters have been used for monitoring people and foods for fission products from nuclear reactors and fall-out, measurements of retention and excretion of small doses of γ-emitting radioisotopes by animals and man, and for tracer studies in clinical diagnosis and research. Data are presented from studies on Cs^{137} in milk and people, an interspecies correlation in the uptake and retention of radionuclides, the uptake and retention of I^{131} by hypothyroid patients before and after the administration of a thyroid-stimulating hormone, the uptake and retention of orally administered Fe^{59} in relation to levels of physiological demand, and the average body K concentration as a function of sex and age. (C.H.)

19115 HUMAN RADIATION EXPOSURE. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). p.373-91 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The biological effects of radiation and medical applications of radiation are reviewed. Radiation detection instruments used in monitoring at diagnostic and tracer levels are discussed. It is concluded that in medical applications of atomic energy overemphasis of radiation safety is more dangerous than underemphasis and that common sense is the only basic rule in medical work. (C.H.)

Biochemistry, Nutrition, and Toxicology

19116 (IEA-22) APLICACAO DO METODO DA DILUICAO DE ISOTOPOS AO ESTUDO DA COMPOSICAO DO CORPO HUMANO. (Application of the Isotopic Dilution Method to the Study of the Composition of the Human Body). Bernardo L. Wajchenberg, Romulo R. Pieroni, Julio Kieffer, J. Schnaider, Oswaldo Gnecco, Aron Gelman, Virgilio G. Pereira, Evaldo de Lucia Mello, and Renato D. Federico (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 29p. (CNEN-IEA-91)

The isotopic dilution method permits the total quantitative determination of substances in vivo. The methods of isotopic dilution are described. As examples of the technique, determinations of the total water and the total exchangeable potassium by isotopic dilution were analyzed. (J.S.R.)

19117 (IEA-28) ELIMINACÃO DA VITAMINA B-12 RECUPERACÃO URINARIA DA VITAMINA MARCADA (B-12, Co-60). (Elimination of Vitamin B-12 and Urinary Recovery of the Labeled Vitamin (B-12, Co^{60}). Romulo R. Pieroni, Alcidio Abrão, Victorio Maspes, and Michel Jamra (São Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 13p. (CNEN-IEA-2)

In the use of "flushing" doses, the most important method for the elimination of vitamin B_{12} is urination. There are indications that the vitamin is partially degraded. If this degradation occurs in the intestine, a reexamination of the methods for the evaluation of intestinal absorption of the vitamin is necessary. The occurrence of the degradation of B_{12} invalidates the results of the metabolic balances, based on microbiological determinations. The data available do not permit the definition of the relative importance of the various ways for the elimination of vitamin B_{12}. (tr-auth)

19118 (IEA-31) CONTRIBUCION AL ESTUDIO DEL METABOLISMO DEL HIERRO EN HEMOPATIAS DIVERSAS MEDIANTE EL EMPLEO DE LOS ISOTOPOS RADIACTIVOS Fe^{59} Y Cr^{51}. (Contribution to the Study of the Metabolism of Iron in Various Hemopatic Patients by the Use of the Radioactive Isotopes Fe^{59} and Cr^{51}). V. Maspes, M. Jamra, R. R. Pieroni, D. M. Cillo, Z. J. Gomes, and S. Morais Rego (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1959. 71p. (CNEN-IEA-5)

The methods used in the study of iron metabolism and the curves obtained are analyzed. The techniques used are described in detail. The role played by the production and destruction of the red cells in the mechanism of anemias studied is emphasized. Conclusions reached on idiopathic acquired hemolytic anemia, congenital hemolytic anemia, pancytopenic cases, and paroxismal nocturnal hemoglobinuria are discussed in some detail. (auth)

19119 (TID-12745) PROGRESS REPORT [ON] TRANSPORT ACROSS CELLULAR MEMBRANES [FOR] JANUARY 1, 1960 TO DECEMBER 31, 1960. A. K. Solomon (Harvard Univ., Cambridge, Mass.). May 12, 1961. Contract AT(30-1)-2453. 11p.

Results are reported from tracer studies of transport across cellular membranes. Data are included from studies of ion transport in bacteria, the diffusion of malonamide into erythrocytes in measurements of membrane pore size, solute movement through artificial colloidal membranes, mineral metabolism and cell membrane permeability of HeLa cells grown in tissue culture, measurements of the pore radius of membranes of the small intestine, Na and water transport across intestinal membranes, and Na transport by isolated frog skin. The relationship between ion transport and electron transport systems was studied with the aid of a double beam spectrophotometer. (C.H.)

19120 (TID-12760) THE EFFECT OF CHELATION ON THE PRODUCTION OF CHROMATID ABERRATIONS IN VICIA FABA. Norman S. Cohn (Ohio Univ., Athens). 1960. Contract AT(11-1)-826. 8p.

Results are reported from a study on the effects of treatment with an iron chelator, 2,2′ bipyridine, KCN, and 1, 2-3, 4-diepoxybutane given singly and in various combinations on the production of chromatid aberrations in Vicia faba. Possible reaction mechanisms involved in the chromosome breaks are discussed. Results are compared with those from previous studies using x radiation. (C.H.)

19121 IRRADIATION FLUOROMETRIC METHOD FOR ESTIMATION OF DIETHYLSTILBESTROL IN BEEF LIVER TISSUE. J. M. Goodyear and N. R. Jenkinson (Eli Lilly and Co., Indianapolis). Anal. Chem., 33: 853-6(June 1961).

An irradiation fluorometric method is devised for determining low levels of diethylstilbestrol in biological samples. Extraneous fluorescence is eliminated by using a split sample technique, increment standards, and a pH change. Radioactive diethylstilbestrol is used to verify the accuracy of chemical extraction. (auth)

19122 THE PHARMACOLOGY AND TOXICOLOGY OF THE BONE SEEKERS. Philip S. Chen, Jr., Raymond Terepka, and Harold C. Hodge (Univ. of Rochester, N. Y.). Ann. Rev. Pharmacol., 1: 369-96(1961).

Basic physiological concepts of bone metabolism are reviewed, with emphasis on ion exchange substitution mechanisms involved in skeletal fixation. The potential hazard to man from the skeletal deposition of radioactive elements produced by nuclear fission are summarized. The relative biological effectiveness of α, β, and γ radiations from internally-deposited radionuclides is considered. It is pointed out that the metabolism and skeletal uptake of Ra, Ca, and Sr are similar. Data on the deleterious effects of Ra^{226} deposited in the human skeleton are reviewed, and the hazards from Sr^{90} in fall-out are discussed in detail. Other radioactive bone-seekers discussed include U, rare earths and actinides. Non-radioactive bone-seekers discussed include F, Be, and Pb. 124 references. (C.H.)

19123 CONTRIBUTION TO THE KNOWLEDGE OF THE RADIOTOXICOLOGICAL PROPERTIES OF CERIUM-144. A. Aeberhardt, P. Nizza, and Y. Arnaud (Comissariat a l'Energie Atomique, [Paris]). Bull. inform. sci. et tech. (Paris), No. 47, 2-22(Jan. 1961). (In French)

The metabolism of carrier-free Ce^{144} in the colloidal and ionic states was studied. The kinetics of the radioisotope in the blood, after intravenous injection, is a function of the physico-chemical state in the injected solution. The initial distribution and the method of transfer in the blood are also functions of the physico-chemical state. In the case of ionic cerium, elimination from the liver is very rapid. Fixation by the skeleton is slower and attains a maximum toward the thirtieth day. Cerium is excreted in the feces. A preliminary study of the radiotoxicity of Ce^{144} in the rabbit shows that 0.66 μc of Ce^{144}-Pr^{144} per gram of body weight causes the death of 8 out of 10 rabbits in sixteen days. The sensitivity of the rabbit appears to be greater than that of the rat after internal radiocontamination, but less after external contamination. Some hematological modifications, after internal contamination, are not superposable on those occurring after external exposure. The cumulative β doses at the liver level after injection of 0.66 μc/g body weight are of the order of 1500 rads on the sixteenth day. (J.S.R.)

19124 NEW METHODS FOR THE BIOLOGICAL PREPARATION OF SOME SULFUR-LABELLED SUBSTANCES. F. Chapeville. Bull. inform. sci. et tech. (Paris), No. 47, 46-9(Jan. 1961). (In French)

A biological method for the preparation of labeled amino acids is described. The method is based on the fact that the vitellin sac and vitellus of the embryonic fowl contains an enzyme which possesses the ability to exchange the cysteine sulfur atom with that of mineral sulfur or of substituting in the sulfhydryl group of the amino acid the sulfonate group formed from the sulfite present in the medium. This enzyme simultaneously catalyzes the transfer of α-hydrogen from the cysteine and its replacement by the hydrogen of water. If the sulfur of the sulfide or sulfite or the hydrogen of the water is enriched in one of their isotopes, these isotopes are incorporated in the organic molecule. The application of this procedure to the preparation of labeled l-cystine and taurine is shown as examples. (J.S.R.)

19125 ON THE TOXICITY OF IRRADIATED AND OXIDATED FAT. A. I. Zhuravlev, M. A. Lomova, and V. N. Benevolenskii. Med. Radiol., 6: No. 2, 46-51(Feb. 1961). (In Russian)

Under investigation was sunflower oil in which the initial stages of auto-oxidation (accumulation of peroxides) were not attended by reactions of hydrolysis (accumulation of free fatty acids) and polymerization. Lipid peroxides inactivate SH-groups of the liver in vitro and in vivo. They are not endowed with hemolytic activity. Upon intraperitoneal administration of the oil to mice, death of the animals is provoked only by the oil in which a rise of the content of free fatty acids was observed. Sunflower oil with a large quantity of peroxides causes no noticeable influence on the vital activity of mice. It has been established that during auto-oxidation in the air the accumulation of peroxides and free fatty acids, as well as the increase of the toxicity, are many times more intensive than during irradiation even in doses over 10^6 r. (auth)

19126 THE TOXICITY OF THORIUM AND OF ITS COMPOUNDS. I. A. Frolova. Med. Radiol., 6: No. 3, 72-7(Mar. 1961). (In Russian)

Thorium-232 which is used for the preparation of uranium-233, is primarily an alpha-emitter and thus presents all the dangers inherent in its nature upon contact. Thorium compounds are widely used in industry but information on their toxicity is scarce. Introduced orally into the organism, the salts hydrolyze, forming the difficultly soluble hydroxide $Th(OH)_4$. The metal, ThF_4 and ThO_2 have a higher solubility in the body fluids than in water, reaching 20% in gastric juice and 2% in blood plasma. Colloidal ThO_2 suspensions are widely used in x-ray diagnosis. Upon intra-arterial introduction of this suspension, the Th deposits primarily in the liver, spleen and bone marrow and to a lesser degree in the suprarenal glands and the kidneys, precipitating out mostly on the cytoplasm. If introduced by other than intravascular means, the Th is resorbed to a lesser degree. Degenerative changes have been noticed after precipitation on the vascular wall. Inhalation of a dust containing 0.1 to 0.2 mg/kg of Th resulted in cases of pneumonia in rats; raising the concentration to 0.5 to 50 mg/kg caused the death of the animals within 2 to 4 months, resulting in the formation of granulation tissue. Inhalation endangers primarily the respiratory organs, damaging in turn the nervous, blood, and cardiovascular systems. (TTT)

19127 PREPARATION OF ZYMASE LABELED WITH CARBON-14. N. L. Samoilina. Med. Radiol., 6: No. 3, 80-1(Mar. 1961). (In Russian)

In order to facilitate the study of the mechanism by means of which high-molecular polysaccharides increase the resistivity of the organism, a zymase labeled with C^{14} was prepared. The originally considered use of P^{32} as

labeling element was rejected in view of the low concentration of P in zymase and the short half of the isotope. For the preparation of the compound labeled with C^{14} a yeast culture was used, employing glucose containing C^{14} as nutrient and NH_4Cl as source of N in the synthetic medium. The culture was kept under sterile conditions at 30°C under continuous aeration for 19 hours. The preparation was carefully washed with distilled water, absolute alcohol and a phosphate buffer solution, yielding a material with a specific activity of 8.64×10^{-2} μc/mg which represents 64% of the original activity of the glucose in the culture. Comparison tests with a similar material prepared without using C^{14}-labeled glucose in vitro and in vivo did not reveal any differences in the behavior of the two materials. The labeled zymase promises to be a useful tool for future studies. (TTT)

19128 THE DISTRIBUTION OF RADIOYTTRIUM AND RADIOACTIVE RARE EARTHS IN MAMMALIAN ORGANISMS. II. THE DISTRIBUTION OF CARRIER-FREE RADIOYTTRIUM (Y^{90} AND Y^{91}) IN THE ORGANISMS OF WHITE MICE AND GUINEA PIGS AS WELL AS THE INFLUENCE OF INACTIVE ISOTOPIC CARRIER MATERIALS ON THE DISTRIBUTION PATTERN. Friedrich Gensicke and Ernst Spode (Institut für Medizin und Biologie der Deutschen Akademie der Wissenschaften, Berlin). Z. Naturforsch., 16b: 170-80(Mar. 1961). (In German)

Factors which can change decisively the distribution pattern of radioyttrium were investigated. In guinea pigs and mice, the effect of the dose weight on the distribution and elimination rate and the dependence on the application method were investigated. After intracardial injection a strong accumulation in the liver and a decrease in the skeleton was observed in guinea pigs after adding inactive isotopic carrier. If radioyttrium is injected subcutaneously or intraperitoneally, an increase of the carrier causes a resorption decrease, but the distribution difference is similar to that after intracardial injection. (tr-auth)

19129 THE DISTRIBUTION OF RADIOCERIUM IN LIVER CELLS AND ITS MODIFICATION BY DIETHYLENE (TRIAMINE)-PENTAACETIC ACID. A. Catsch, H. Immel-Teller, and D. Schindewolf-Jordan (Institut für Strahlenbiologie, Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 16b: 181-5(Mar. 1961). (In German)

The distribution of carrier-free radiocerium over the cell fractions of liver homogenates was investigated in rats. The distribution pattern shows, during the first days, strong variation. An equilibrium appeared between the single subcellular fractions the first four days after injection, that is, absorption in cytoplasm > mitochondria > microsomes. An analysis of the distribution pattern after single injections of a chelate builder led to the assumption that the builder could be enriched to some extent in the intracellular space. (tr-auth)

19130 THE TURNOVER OF RADIOELEMENTS IN CLINICAL MEDICINE. Robert vanHoek (Walter Reed Army Medical Center, Washington, D. C.). p.299-310 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Applications of whole-body counting techniques in clinical and metabolic tracer studies are described. The studies were accomplished using a 4π liquid scintillation detector. It was concluded that whole-body counting permits the use of lower doses of radioactivity as compared with conventional tracer techniques. Counting times are short and laborious sample preparation is avoided. (C.H.)

Fallout and Ecology

19131 (CEA-1588) LA CONTAMINATION RADIOACTIVE DES MILIEUX ET DES ORGANISMES AQUATIQUES. (Radioactive Contamination of Aquatic Media and Organisms). Y. Fontaine (France. Commissariat à l'Energie Atomique, Centre d'Etudes Nucléaires, Saclay). 1960. 158p.

A series of observations carried out in the field on the extent of contamination in aquatic organisms with respect to that of the medium is described. The experimental studies are then analysed, with reference both to radioisotope metabolism and to factors and types of contamination of aquatic organisms by wastes from atomic industry. A precise experimental project is outlined. 300 references. (auth)

19132 (TID-3908) AN ANNOTATED BIBLIOGRAPHY ON THE USES OF STATISTICS IN ECOLOGY—A SEARCH OF 31 PERIODICALS. Vincent Schultz (Division of Biology and Medicine, Environmental Sciences Branch, AEC). 1961. 315p.

This bibliography is the result of an extensive literature search on uses of statistics in the fields of wildlife, fisheries, limnology, oceanography, and related fields. (C.H.)

19133 (TID-12618) UPTAKE, TRANSPORT, AND EFFECTS OF RADIOACTIVE MATERIALS ON AQUATIC ECOSYSTEMS. Final Report. (Michigan. Univ., Ann Arbor). Mar. 1961. Contract AT(11-1)-781. 32p. ([ORA]-02934-2-F)

Progress is reported in a study on the role of various groups of organisms in the metabolism of microorganisms in natural waters and the effect of ionizing radiation on the activities of individual organisms and populations within the aquatic ecosystem. Data are summarized on temperature, dissolved oxygen, concentration of carbohydrate and N, and rate of uptake of carbohydrate and N by bacteria in Frains Lake, Washtenaw Co., Mich. Results are included from preliminary studies on the uptake of C^{14}-labeled bacteria by zooplankton. (C.H.)

19134 (CEA-tr-R-1243) COEFFICIENTS D'ACCUMULATION DES ISOTOPES RADIOACTIFS DE 16 ELEMENTS DIFFERENTS PAR LES ORGANISMES D'EAU DOUCE ET INFLUENCE DU COMPLEXON EDTA SUR CERTAINS D'ENTRE EUX. (Accumulation Coefficients of Radioactive Isotopes of 16 Different Elements by Fresh-Water Organisms and the Effect of Complexon EDTA on Some of These Coefficients). N. V. Timofeev-Resovskii, E. A. Timofeeva-Resovskaya (Resovskaia), G. A. Miliutina (Milioutina), and A. B. Getzova (Gezova). Translated into French from Doklady Akad. Nauk, S.S.S.R., 132: 1191-4 (1960). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 21272.

19135 ZINC-65 IN MARINE ORGANISMS ALONG THE OREGON AND WASHINGTON COASTS. D. G. Watson, J. J. Davis, and W. C. Hanson (General Electric Co., Richland, Wash.). Science, 133: 1826-8(June 9, 1961).

The concentration of zinc-65 in marine animals and plants near the mouth of the Columbia River is presented. Amounts of radiozinc found in the biota diminished rapidly with the distance from the river mouth. The highest levels were found in plankton, algae, and mollusks. Of the human foods, oysters exhibited the highest levels. (auth)

Radiation Effects on Living Tissues

19136 (AFSWC-TN-61-3) BIOLOGICAL RECOVERY FROM RADIATION DAMAGE IN SMALL ANIMALS. John W. Lane and Walter Mauderli (Arkansas. Univ., Little Rock. [School of Medicine]). Mar. 1961. Contract AF29 (601)-1160. 31p.

Male, black C_{57} mice were exposed to multiple, small acute doses of gamma radiation from a Co^{60} source. Following a recovery period of one month, the dose required to result in a mean survival time of 30 days was determined. The differences in doses required for mice subjected to 600 and 1200-r priming doses and that required in non-irradiated controls was seen to be 20 and 15.8% respectively. This residual radiation damage is felt to be high when compared to other reported data, and possible reasons for this are considered. A mathematical model is presented which describes radiation damage and its subsequent repair. An analog computer was utilized to study the possible curves resulting when the parameters and constants of the model were varied. These curves were compared to available experimental data and the contents for the best fit of the experimental points to the computer curves were determined. The results are promising, but more experimental data and further study of the analog computer curves are necessary. (auth)

19137 (NP-10154) INVESTIGATIONS ON THE PROBLEM OF FORMATION AND PATHOPHYSIOLOGICAL SIGNIFICANCE OF BIOGENIC AMINES IN SUBLETHAL RADIATION INJURIES. Quarterly Technical Status Report No. 2, January 1–March 31, 1961. (Cologne. Universitat. Medizinische Klinik). Apr. 28, 1961. 10p.

Progress is reported in studies on the formation of amines following sublethal radiation injury. Procedures are described for the quantitative determination of single amines in blood, urine, and tissues. (C.H.)

19138 (NP-10165) CHRONIC WHOLE-BODY GAMMA RADIATION STRESS IN THE ALBINO RAT AND MOUSE. Progress Report, March 1960–February 1961. Sidney O. Brown (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station. Radiation Biology Lab. and Texas Agricultural and Mechanical Coll., College Station. Research Foundation). Apr. 1961. Contract DA-007-49-MD-957. 78p.

Progress is reported in a series of studies on the effects of chronic γ irradiation in mice and rats. Doses ranged from 2 to 20 r per day. The irradiation facility and provisions for animal care are described. Data are included from studies on life span, incidence of neoplasms, hematology, testicular function, development, growth, rate of maturation, the healing of bone lesions, and survival after burn trauma of chronically irradiated mice or rats. Data are included from preliminary tests of the chronic toxicity of mercaptoethylamine in mice. (C.H.)

19139 (NP-10175) PROPOSAL TO INVESTIGATE THE CHANGE IN URINARY CONSTITUENTS AS A MEASURE OF RESPONSE TO WHOLE BODY IRRADIATION. Oct. 20, 1960. (KN-60-652(P)). Includes Reports: KN-60-652(CP): COST PROPOSAL TO INVESTIGATE THE CHANGE IN URINARY CONSTITUENTS AS A MEASURE OF RESPONSE TO WHOLE BODY IRRADIATION. Oct. 20, 1960. KN-60-673-A(P): PROPOSAL TO INVESTIGATE THE CHANGE IN URINARY CONSTITUENTS AS A MEASURE OF RESPONSE TO WHOLE BODY IRRADIATION. Nov. 28, 1960. KN-60-673-A(CP): PROPOSAL FOR A COST-PLUS-FIXED-FEE CONTRACT. PROPOSAL TO INVESTIGATE THE CHANGE IN URINARY CONSTITUENTS AS A MEASURE OF RESPONSE TO WHOLE BODY IRRADIATION. Nov. 28, 1960. (Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs). 193p.

Various physiological modifications following gamma radiation were examined. Emphasis was placed on those which may be caused by, or aided by, alteration in degree of endocrine activity. An attempt was made to correlate the modifications with dosage or gross physical effects. Young, male, Charles River rats were exposed to whole-body doses of 0.25, 2.8, 29, 289, 729, 763, 804, 842, and 1040 rads of Co^{60} radiation. The urines were analysed in particular for calcium, phosphate, and urea content. It was found that other stress induction modifies the response, but that the change induced by irradiation is still clearly indicated. The values for the first 24 hours after exposure were clearly grouped into those that will survive for 30 days post irradiation and those that will die within the 30 day period. Those that die have a high excretion rate of the measured constituents and those that survive have a marked retention. The responses measured clearly begin at levels as low as 2.8 rads. (auth)

19140 (NP-10228) QUARTERLY PROGRESS REPORT NO. 39. (Chicago. Univ. Air Force Radiation Lab.). Apr. 15, 1961. Contract AF41(657)-252. 163p.

Separate abstracts have been prepared on the 12 sections of this report. (C.H.)

19141 (NP-10228(p.1-11)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. THE ABILITY OF CHEMICAL AGENTS TO MODIFY THE RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES OF THE HEMATOPOIETIC TISSUES AND SMALL INTESTINE. Bernard E. Hietbrink, Ann R. Raymund, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

The modification of the radiation-induced changes in the adenosine triphosphatase activity of the spleens and thymus glands and in the acetylcholinesterase activity of the small intestines of rats treated with chemical agents before exposure to x irradiation was used as a means of quantitatively determining the degree of radioprotection provided. Various dosage levels of semicarbazide hydrochloride were tested for radioprotective effect. A dose of 150 mgm/kgm caused a dose reduction of 31% in the spleen and 27% in the intestine but did not benefit the thymus glands. One hundred mgm/kgm or 175 mgm/kgm of this compound did not provide significant dose reductions in the tissues studied. Tissues of rats given 1 mgm/kgm of sodium fluoroacetate at 1, 2, 3, and 4 hours before 400 r were assayed for radioprotective effects. Results of these experiments indicate that the most substantial dose reductions in the spleen were obtained when animals were given fluoroacetate two or three hours before irradiation while the greatest degree of intestinal protection was observed in rats given the drug one hour before exposure. A dose of 350 mgm/kgm of mercaptoethyldithiocarbamate (MEDTC) provided marked dose reductions of 49% in the spleen, 23% in the thymus glands and 33% in the intestine. Increasing the dose to 400 mgm/kgm caused 46, 25, and 37% dose reductions in the respective tissues. Various combinations of MEA and serotonin were very effective in reducing the radiation-induced changes in the enzyme activity of the spleen and small intestine. Thus, 150 mgm/kgm of MEA plus 20 mgm/kgm of serotonin provided dose reductions of 46% in the spleen and 100% in the intestine but did not benefit the thymus glands. Dose reductions of 47% in the spleen, 18% in the thymus glands and greater than 70% in the in-

testine were observed when 200 mgm/kgm of MEA and 10 mgm/kgm of serotonin were administered prior to 400 r. Twenty % of the animals given 150 mgm/kgm of semicarbazide before exposure to 850 r survived the 30-day test period. MEDTC permitted survival of 100% and 80% of the rats given 850 r and 1000 r respectively. The combinations of 150 mgm/kgm of MEA plus 20 mgm/kgm of serotonin and of 200 mgm/kgm of MEA plus 10 mgm/kgm of serotonin protected all of the animals given 1200 r, however, neither combination afforded protection against mortality caused by 1400 r. (auth)

19142 (NP-10228(p.12-27)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. THE EFFECTS OF VARIOUS CHEMICAL COMPOUNDS ON THE NITROGEN MUSTARD (HN1)-INDUCED CHANGES IN ENZYME ACTIVITIES OF CERTAIN TISSUES OF RATS. Bernard E. Hietbrink, Ann B. Raymund, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Measurements of the effect of 0.5 mgm/kgm of HN1 on the adenosine triphosphatase activity of the spleens and thymus glands of rats indicated that this nitrogen mustard caused an increase in enzyme activity that was evident within 24 hrs reached a maximum at three to five days in the spleen and at five to seven days in the thymus glands and returned toward normal after ten days. The increase in enzyme activity was dose dependent in these tissues following doses as great as 0.75 mgm/kgm. Several sulfur-containing compounds and combinations of these compounds, known to protect against the damaging effects of x irradiation and HN2, were tested for their ability to reduce the HN1-induced increase in the adenosine triphosphatase activity of the spleen and thymus glands. DMDTC, DEDTC, cysteine, and combinations that included these agents were capable of markedly reducing the increase in enzyme activity of these tissues caused by HN1. MEA and GSH provided significant beneficial effects while AET failed to reduce the increase in adenosine triphosphatase activity produced in the spleen and thymus glands by the nitrogen mustard. Measurements of the effect of 0.5 mgm/kgm of HN1 on the acetylcholinesterase activity of the small intestine indicated that this nitrogen mustard caused a decrease in activity that was evident at two days after injection. The enzyme change reached a maximum at three to four days and returned to normal after ten days. A dose of 0.25 mgm/kgm caused a substantial decrease in the intestinal cholinesterase activity and doses in excess of 0.5 mgm/kgm did not produce a further decrease in enzyme activity at three days after injection. Injection of DMDTC, DEDTC, cysteine, or combinations that included these agents before HN1 markedly reduced the decrease in cholinesterase activity caused by ordinarily lethal doses of the nitrogen mustard. GSH and MEA provided substantial protection against the decrease in enzyme activity produced by 0.75 mgm/kgm of HN1 while AET did not prevent the marked decrease in cholinesterase activity caused by the nitrogen mustard. (auth)

19143 (NP-10228(p.28-35)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. FURTHER STUDIES ON THE INFLUENCE OF HORMONES ON RADIATION INJURY IN RATS. Esmat A. Ezz and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Testosterone treatment of weanling male rats did not affect the adenosine triphosphatase activity of the spleen or the cholinesterase activity of the intestine and had no effect on the injury of these tissues produced by 400 r of x ray. Hypophysectomized, weanling female rats exhibited less injury to the spleen and intestine following exposure to 400 r than normal weanling females. Treatment of hypophysectomized, female weanling rats with estradiol resulted in some protection of the spleen and intestine from radiation injury in contrast to the increased radiation injury which occurs in weanling female rats treated with estradiol when the pituitary gland was not removed. (auth)

19144 (NP-10228(p.36-41)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. IV. INFLUENCE OF CHANGES IN BODY pH ON RADIATION INJURY IN RATS. Esmat A. Ezz and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Production of a state of alkalosis by sodium bicarbonate and acidosis by ammonium chloride did not alter the adenosine triphosphatase activity of the spleens or the cholinesterase activity of the small intestine of unirradiated rats. Following exposure to 400 r of x ray, rats that were maintained in a state of alkalosis for a week before radiation exposure and for three days after exposure appeared to be somewhat less susceptible to radiation injury on the basis of adenosine triphosphatase measurements on the spleen and body weight measurements. However, intestinal injury was not affected by the treatment. Acidosis induced by ammonium chloride had no protective effect against radiation injury to the intestine or spleen and it accentuated the loss of body weight after 400 r of x ray. (auth)

19145 (NP-10228(p.42-58)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. EFFECTS OF ADDING A HEPATOTOXIC AZO DYE TO THE DIET OF CHRONICALLY IRRADIATED MICE. C. F. Holoway, J. Cowan, et al., (Chicago. Univ. Air Force Radiation Lab.).

Adult female CF_1 mice will not tolerate 4-o-tolylazo-o-toluidine (TAT) in the diet at levels greater than 900 ppm for a period of sixteen weeks without exhibiting a mortality of nearly 100%. The mortality rate and, to some extent, the loss in body weight of mice fed TAT-containing diets appears to be related to the dietary level of TAT. Aged CF_1 female mice and young female C57B1 mice appear to be more susceptible to the toxic effects of TAT in the diet than young female CF_1 mice. The mortality rate and loss in body weight of mice fed TAT-containing diets is increased when the animals are given daily whole body-gamma irradiation exposures of 10, 20, or 40 rep/day. Chronic exposure to gamma irradiation also enhanced the pathologic effects of TAT feeding on the livers of CF_1 mice. The spectrophotometric characteristics of TAT were investigated in preparation for studies to compare the distribution and metabolism of this dye in normal and chronically irradiated mice. (auth)

19146 (NP-10228(p.59-65)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies on the mortality of rats given the rare earth nitrate salts of didymium, Ce, Nd, Sm, Tb, Dy, Ho, and Lu with 500 r of whole-body irradiation demonstrated that the rare earths caused an increase of 32 to 82% in mortality as compared with irradiated controls. Radiation alone caused only an occasional death during the 30-day observa-

tion period. Limited studies with 500 r of whole-body radiation and 150, 112.5, and 75 mgm/kgm of Er nitrate demonstrated an observed mortality of 77, 60, and 40% respectively during a 30-day period. This indicates that radiation may cause a direct dose reduction in the LD_{50} value of Er nitrate. No deaths were observed when 181 mgm/kgm of sodium nitrate was given to irradiated (500 r) or un-irradiated rats. This tends to indicate that the toxicity of the rare earth nitrates and their additive effects on radiation injury are due primarily to the rare earth elements. (auth)

19147 (NP-10228(p.66-79)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. III. HISTOPATHOLOGIC EXAMINATION OF TISSUES FROM RATS GIVEN RARE EARTH NITRATES AND X-IRRADIATION. D. Vesselinovitch, F. W. Fitch, et al., (Chicago. Univ. Air Force Radiation Lab.).

The main histopathological findings observed were fibrous and granulomatous inflammation of the peritoneum and peritoneal surfaces of the liver, splenic capsule, in the periovarial adipose tissue, periadrenal tissue, and fibroadipose tissue overlying the capsule of the kidney. Other findings included atrophy of the lymphoid tissue in the spleen, hemorrhages in the sinusoides of the mesenteric lymph node and degeneration and retardation in the development of the ova in the ovaries and some increase of the stainable fat in hepatic cells. It is of interest that the degree of fibrous, granulomatous peritonitis was considerably more severe in animals receiving intraperitoneal injection of the rare earth compounds followed by total body x irradiation than in animals receiving the compound alone. The reason for this increased effect is not clear from the present study. No such peritonitis was present in animals receiving a single dose of total-body x irradiation. Whether this fibrous, granulomatous inflammation of the serous membrane is due to the direct toxic effect of the rare earth compounds has not been determined. Fibrous peritonitis seen after intraperitoneal injection of rare earth is increased by administration of x irradiation. When combined with x irradiation, Eu, seems to be most toxic follwed by Er, and Gd in that order. Foreign body, multinucleated giant cells had occasionally in our sections as many as twenty nuclei. The frequently observed basophilic irregular material is not the compound itself because rare earth salts when injected intradermally could not be detected microscopically. The basophilic material did not stain with Feulgen stain but stained positively for phosphorus by Von Kossa stain so it could be suspected that much of it is Ca. Peritonitis and ascites were also observed. (auth)

19148 (NP-10228(p.80-4)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. IV. INFLUENCE OF DAILY EXPOSURE TO LOW DOSES OF GAMMA RADIATION ON THE HEMATOPOIETIC TISSUES OF RATS. Kenneth P. DuBois and Ann B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

The chronic effects of Co^{60} gamma radiation were studied in rats by exposing the animals to 10 r per day given over a 12-hr period. Adenosine triphosphatase assays on the spleens and thymus glands were performed to obtain a quantitative measurement of the amount of injury to the hematopoietic tissues. Daily exposure to 10 r of gamma radiation caused a progressive increase in the adenosine triphosphatase activity of the spleen from 19.3 units to 29.9 enzyme units in 23 days. The activity was maintained at this level throughout the 83-day exposure period. The adenosine triphosphatase activity of the thymus glands exhibited an increase in response to 10 r per day of gamma radiation but the amount of increase was much smaller than would be obtained with comparable single doses and the injurious effects of acute and chronic doses of radiation in this tissue are thus much different than in the spleen. (auth)

19149 (NP-10228(p.85-95)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. V. EFFECTS OF AGE AND RADIATION EXPOSURE ON THE GLUCOSE TOLERANCE AND CYTOCHROME OXIDASE ACTIVITY OF THE LIVERS OF CF_1 FEMALE MICE. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Measurements of the cytochrome oxidase activity were carried out in the livers of young and old CF_1 female mice. The activity of this enzyme was found to be significantly higher in the livers of the younger animals. Whole-body x-ray exposure (800 r) reduces slightly the cytochrome oxidase activity in the livers of both young and old mice. The effect was somewhat greated in the young than in the old mice. Glucose tolerance curves have been obtained in CF_1 female mice exposed to single whole-body x irradiation at dosage levels of 400 r, 600 r, 800 r, and 1200 r of x ray. X-ray exposure causes an elevated glucose tolerance curve and the effect is related to the radiation dose within the range of 400 r through 800 r. (auth)

19150 (NP-10228(p.96-138)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. THE INFLUENCE OF DITHIOOXAMIDE DERIVATIVES ON RADIATION LETHALITY IN MICE. Vivian Plzak and John Doull (Chicago. Univ. Air Force Radiation Lab.).

Forty-five N,N′-di-substituted derivatives of dithiooxamide were tested for protective activity against radiation lethality in mice. Nearly one-third of these derivatives were found to exhibit significant radioprotective activity. Maximal radioprotective activity was obtained with N,N′-dioctodecyl dithiooxamide (MK-34) which permitted 70% of the animals to survive for 30 days after an x-ray exposure of 700 r. Thirty-day survivals of 50% were obtained in x-rayed mice treated with N,N′-bis(2-hydroxyethyl) dithiooxamide (MK-5), N,N′-bis(carboxypentyl) dithiooxamide (MK-12), N,N′-bis(9-xanthenyl) dithiooxamide (MK-71), and N,N′-diallyl dithiooxamide (ML-36). N,N′-bis(2-hydroxyethyl) dithiooxamide (MK-5) reduces radiation lethality in both rats and mice when given prior to the radiation exposure. Maximal protective effects are obtained when the compound is administered shortly before the x-ray exposure and post-irradiation administration is ineffective. The protective effect of MK-5 is greater when propylene glycol is used as a vehicle than when the compound is given with water as the vehicle. Optimal radioprotective activity is obtained in mice with a dosage level of 200 mgm/kgm intraperitoneally and in rats with a dosage level of 500 mgm/kgm. The radioprotective effect of N,N′-bis(2-hydroxyethyl) dithiooxamide (MK-5) is decreased when the mice are subjected to high oxygen pressure during the radiation exposure. The administration of MK-5 decreases the whole-body oxygen consumption of CF_1 mice by about 25% but does not markedly affect the oxygen tension in the spleen as measured polarigraphically using needle electrodes. The administration of combinations of p-aminopropiophenone (PAPP) and N,N′-bis(2-hydroxyethyl) dithiooxamide (MK-5) and serotonin (5-HT) plus MK-5 gives

a greater protective effect than the administration of either agent alone. These effects depend, however, on the order in which the compounds are administered. (auth)

19151 (NP-10228(p.139-55)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. PROTECTION AGAINST CHRONIC RADIATION LETHALITY IN MICE. J. Doull, V. Plzak, and M. Root (Chicago. Univ. Air Force Radiation Lab.).

Preirradiation treatment with mercaptoethylamine (MEA, 200 mgm/kgm/day) does not prevent the lethal effect of chronic radiation exposure in mice in the dosage range of 40 r through 200 r per day. Rather MEA pretreatment shortens the median survival time (ST_{50}) of chronically irradiated mice and the effect is inversely related to the daily dose of radiation employed. Anoxia produced by decreasing the environmental oxygen level to 7% during the radiation exposure is also ineffective in preventing the lethal effects of chronic radiation exposure in mice. Shielding of the head or pelvis (including the tail) during chronic radiation exposure is more effective in preventing the lethal effects of chronic exposure to 100 r/day than in mice exposed to 50 r/day. However, shielding of either of these areas is less effective than shielding of either the thorax or abdomen. Shielding of the thorax is an effective in preventing chronic radiation lethality in mice given daily x-ray exposures of 50 r or 100 r as is abdomen shielding. These studies demonstrate that the hematopoietic system is of greater importance in the lethal effects of acute radiation exposure than in chronic radiation exposure and suggest that other organ systems (possibly the liver) are responsible for at least part of the manifestations of chronic radiation injury. (auth)

19152 (NP-10228(p.156-63)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. POLAROGRAPHIC ESTIMATION OF OXYGEN TENSION AND SULFHYDRYL LEVELS IN MOUSE SPLEEN FOLLOWING INJECTION OF RADIOPROTECTIVE AND RELATED COMPOUNDS. H. D. Landahl and A. Hasegawa (Chicago. Univ. Air Force Radiation Lab.).

An apparatus to measure polarographically the oxygen tension and sulfhydryl levels in tissues is described. With the compounds tested for their effect on spleen oxygen, those reported to be good protectors produced greater decrease in spleen oxygen. With compounds tested for the effect on the sulfhydryl level in the spleen, compounds which increase the sulfhydryl levels show radioprotective activity with one exception. Two compounds which showed no appreciable increase in sulfhydryl levels, however, gave moderate to slight protection in one or more experiments. (auth)

19153 (NYO-9633) FINAL REPORT ON EFFECTS OF X-RADIATION. Richard Wagner (Tufts Univ., Boston. School of Medicine). May 22, 1961. Contract AT(30-1)-1673. 16p.

Progress is reported in studies on the in vitro effects of x radiation on the nucleic acids of horse leukocytes and blood platelets. Results are reported from a series of studies on the protective effects of glutathione against a lethal dose of x radiation in guinea pigs. Possible reaction mechanisms involved are discussed. Good results are reported from preliminary studies on the protective effects against radiation injuries in guinea pigs of sodium salt of ribonucleic acid. A list is included of publications during the period. (C.H.)

19154 (TID-12632) IRREPARABLE BIOLOGICAL DAMAGE AND ITS INFLUENCE ON REPAIR RATE. J. F. Spalding, T. T. Trujillo, and W. L. LeStourgeon (Los Alamos Scientific Lab., N. Mex.). [1960]. 16p.

Nine hundred female RF mice were given conditioning exposures of Co^{60} γ rays ranging from 0 to 2000 rads by the fractionation method. Following 90 days of repair and recuperation, all groups were exposed to 450 rads of Co^{60} γ rays semiweekly to death. Accumulated median lethal doses and their equivalent acute values were calculated and compared to predicted values based on 5% irreparable injury and a 7-day repair half time. It was observed that predictions were accurate to within 3% of actual equivalent acute values. Observations were in support of the theory that irreparable damage from Co^{60} γ rays is lethal bound, having little or no effect on the repair rate. (auth)

19155 (TID-12663) FINAL REPORT OF A QUANTITATIVE AND MORPHOLOGIC STUDY OF RADIATION INDUCED CATARACTS. (Iowa. State Univ., Iowa City). [1961]. Contract AT(11-1)-72. 34p.

The etiology of radiation cataracts is reviewed, and reaction mechanisms involved are discussed. Data are tabulated on the effects of neutrons of different energies, x radiation delivered as single and fractionated doses, exposure of the whole or a part of the lens, and other variables on the induction of cataracts in mice, rabbits, and ground squirrels. It is concluded that there is less recovery and that recovery is slower following exposure to neutrons than following exposure to x radiation. The size of the individual fractional dose and the interval of time between exposures also has an effect on recovery. (C.H.)

19156 (TID-12683) STUDY OF THE PARTICLE STRUCTURE OF BACTERIA AFTER IRRADIATION. Progress Report, June 1, 1960–April 1, 1961. Ernest C. Pollard (Yale Univ., New Haven). Apr. 24, 1961. Contract AT(30-1)-2540. 38p.

Results are reported from a series of studies on the effects of ionizing radiation on various aspects of cellular metabolism, as illustrated by E. coli. P^{32} and S^{35} were used to measure ribosome formation after irradiation. Data are included on the radiosensitivity of cells grown in a D_2O medium, and the leakage of cellular components from irradiated cells. A theoretical analysis was made of the synthetic mechanisms in cells. (C.H.)

19157 (TID-12720) THE PRODUCTION OF CHROMATID ABERRATIONS BY DIEPOXYBUTANE AND AN IRON CHELATOR. Norman S. Cohn (Ohio Univ., Athens). [1961]. Contract AT(11-1)-826. 7p.

Preliminary studies showed that chromatid breaks produced by certain radiomimetic agents in combination do not interact to produce reunions. Results are reported from a series of studies on the roots of Vicia faba treated with radiomimetic agents and on iron chelator, x radiation, 1,2-3,4 diepoxybutane, or 2,2′ bipyridine. Results tend to support a conclusion that the mode of action of radiomimetic compounds is different from that of ionizing radiation. It is concluded that induced chromosome break rejoining may involve both a time factor and a consideration of the types of chemical bonds disrupted. (C.H.)

19158 (UCLA-473) THE EFFECT OF X-IRRADIATION ON SELF STIMULATION OF THE BRAIN. Thomas J. Haley, P. Bach-y-Rita, and N. Komesu (California. Univ., Los Angeles. School of Medicine). May 5, 1961. Contract AT(04-1)-GEN-12. 9p.

Non-lethal, 600 r, acute whole-body x-irradiation of rats with an electrode implanted in the posterior hypothalamus produced different rates of lever-pressing activity. High rates were obtained from the nucleus arcuatus hypothalami, nucleus dorsomedialis hypothalami, and area lateralis hypothalami, prior to and on the day of radiation. Low rates were obtained from the same nuclei prior to and after irradiation. The present experiments do not show whether these effects are a direct or an indirect effect of x irradiation. (auth)

19159 (AEC-tr-4427) CONTRIBUTION TO THE STUDY OF MEDULLARY SYNDROME FOLLOWING IRRADIATION: AN EXPERIMENTAL STUDY. Henri Maisin. Translated from a publication of Editions Arscia S. A., Brussels, 1959. 330p.

A series of studies on medullary radiosensitivity in rats, mice, and guinea pigs led to the conclusion that medullary syndrome is responsible for deaths occurring between the 6th, 7th, and 30th day following total irradiation at a lethal dose calculated for the 30th day. Death by medullary syndrome can be prevented to a certain extent by injecting mercaptoethylamine (MEA) prior to irradiation; the dose reduction factor is 1.18. Death by medullary syndrome can be avoided by the mechanical protection of the active bone marrow. The medullary syndrome can be cured by injecting isologous bone marrow after irradiation. Such an implant does not replace the host's marrow but enables the host to survive until its own marrow regenerates. Homologous bone marrow implants are efficient as far as medullary syndrome is concerned provided they are histocompatible. Histocompatibility does not depend only on the magnitude of the x-ray dose administered, but on the strains of the donors and recipients as well as on the individuals themselves. Tolerance to blood elements manufactured by the implant does not necessarily follow the tolerance of the implant. Just as the isologous implant gives the host time to regenerate its own marrow, so does the heterologous implant. Heterologous implants can save an animal from medullar death. The remarks made about homologous implants are equally true of heterologous implants. In the light of these experiments, it is possible to define a therapeutic approach for subjects accidentally irradiated in toto and for treatment of leukemic cases, and patients affected with certain forms of radiosensitive generalized cancer. (479 references.) (auth)

19160 (AEC-tr-4601) ACTION OF X-RAYS ON THE GROWTH OF CULTURES OF A ONE-CELLED CHLOROPHYLL ORGANISM: SCENEDESMUS CRASSUS CHOD. (CHLOROPHYLL ALGAE). Roland Gilet and Paul Ozenda. Translated by M. S. Feldman from Compt. rend., 250: 1552-4(Feb. 22, 1960). 2p.

Results are reported from a series of studies on the effects of x irradiation on growth and metabolism of a one-celled chlorophyll algae, Scenedesmus crassus. At doses ranging from 25000 to 35000 r growth continued for a few days and then stopped. Reinoculation of the culture with fresh cells resulted in normal growth, indicating the inhibiting effect was not due to toxic products liberated by the irradiated cells, but due to the inability of the cells to divide. (C.H.)

19161 (CEA-tr-R-1285) ACTION DES RADIATIONS IONISANTES FUR LE SANG CONSERVE ET LE PLASMA. (Action of Ionizing Radiation on Blood Conservation and Plasma). V. N. Vorob'ev (Vorobiev), Z. I. Sheremet, and M. O. Raushenbakh (Raushenbach). Translated into French from Med. Radiol., 4: No. 6, 65-73(1959). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 16706.

19162 THE EFFECT OF IRRADIATION ON CELL DEGENERATION AMONG DEVELOPING NEURONES IN XENOPUS LAEVIS. A. F. W. Hughes and J. A. F. Fozzard (Anatomy School, Cambridge, Eng.). Brit. J. Radiol., 34: 302-7(May 1961).

In the development of the vertebrate nervous system not all the neuroblasts complete their development into neurones. In the lumbar ventral horns of the larvae of Xenopus laevis, the number of viable and degenerating cells has been counted throughout development. Given an estimate of the duration of cell death, the total number of cells which degenerate can be calculated. For every cell which finally differentiates, eight or nine die during development. The death rate of cells in the ventral horns can be reduced or abolished by x rays at a dosage of 80 to 160 r. This arrest may persist for nearly three weeks with relatively young tadpoles, but for only a few days with older animals. When larvae are irradiated near the maximal period of normal degeneration, the arrest of degeneration is evident within a few hours after treatment. The effect is thus shown to be more than a secondary consequence of a general halt in development. (auth)

19163 THE RELATIVE BIOLOGICAL EFFICIENCY OF 8 MV X RAYS AND RADIUM GAMMA RAYS, WITH REFERENCE TO BUCCAL MUCOSA. Robert Morrison, Thomas J. Deeley, and David K. Bewley (Hammersmith Hospital, London). Brit. J. Radiol., 34: 308-12(May 1961).

The relative effectiveness of x radiation generated at 8 million volts and γ radiation from Ra is compared in patients having treatment for cancer of the anterior part of the mouth. The onset of the mucosal reaction has been used as the indicator of biological effect. Comparison of the doses received on the mucosa on the day of onset of the reaction suggests that the RBE of 8 Mv x radiation as compared with γ rays is slightly less than unity. Factors which may affect the reaction other than the energy of the radiation are discussed. (auth)

19164 THE RELATIVE BIOLOGICAL EFFICIENCY OF X RAYS GENERATED AT 220 kVp AND GAMMA RADIATION FROM A COBALT 60 THERAPY. E. J. Hall (Churchill Hospital, Oxford). Brit. J. Radiol., 34: 313-17(May 1961).

Established techniques with broad bean roots were used to measure the relative biological efficiency (RBE) of Co^{60} γ rays from a kilocurie therapy unit and x rays generated at 220 kvp. The value of the RBE was found to be 0.84 with 95% confidence limits of ±0.05. There was no significant difference in the RBE when the irradiation with the Co^{60} γ rays was carried out 1.5 or 20 cm deep in a water-filled phantom. (auth)

19165 GAMMA IRRADIATION CONTAINERS FOR SMALL ANIMALS. G. Gaude and A. Aeberhardt. Bull. inform. sci. et tech. (Paris), No. 47, 65-70(Jan. 1961). (In French)

The gamma irradiation installation for small laboratory animals such as rats or mice at Saclay is described and illustrated. The experimental methods used for the determination of the dose are discussed, and the dose measured for various source positions are tabulated. (J.S.R.)

19166 A COMPARISON OF THE EFFECTS OF A SINGLE FAST NEUTRON DOSE ON THE TESTES OF MICE AS COMPARED WITH THE SAME DOSE ADMINISTERED IN FRACTIONS. N. I. Nuzhdin. M. D. Pomerantseva, and

N. N. Kuznetsova (Inst. of Genetics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 438-40(Mar. 11, 1961). (In Russian)

Male white mice were subjected to a fast neutron dose of 100 rads to the whole body in one single dose and in four separate daily doses of 25 rads each. The mice were killed at 2, 7, 21, 35, 49 and 70 days after irradiation, and the testes were weighed and subjected to histological examination. The effects of the single dose and of the fractionated dose on the weight loss of the testes are identical. There is a significant weight loss of the testes that reaches a maximum on the 35th day after irradiation. However, the weight loss of the spleen is lower with the fractionated dose than it is with the single dose. The histological examination of the testes involved fixation and staining of sections 6 μ thick. A count of various types of embryonic cells present in 100 ducts of the middle of the section showed that fast neutrons are about 5 times more harmful than x-rays, but no differences could be detected in the damage caused by a single dose as compared to a fractionated dose. Irradiation of the testes with fast neutrons leads to a gradual disappearance of the younger embryonic cells or spermatogonia. (TTT)

19167 THE SIGNIFICANCE OF OVARIAL HORMONES IN THE PATHOGENESIS OF RADIATION DAMAGE IN RAT EMBRYOS AFTER THE IRRADIATION OF FEMALE GAMETES WITH X-RAYS. E. A. Pozhidaev (Inst. of Experimental Medicine, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 441-4(Mar. 11, 1961). (In Russian)

White female rats were given a whole-body, x-ray dose of 600 r under the following conditions: 1) irradiation before pregnancy; 2) irradiation and transplantation of two healthy ovaries directly after irradiation; 3) irradiation and transplantation of two healthy ovaries on the day of conception; 4) irradiation and transplantation of two healthy ovaries directly after irradiation with subsequent removal of the transplant on the day of conception. The period between the time of irradiation and the time of conception varied from 1 to 10 days. The percent of implantations and of dead embryos was determined on the 17th day of pregnancy. The results show that the percent of live embryos is 10.2 ± 5.1% greater for the irradiated rats with transplantation than for the irradiated rats without transplantation. If the transplantation is made on the day of conception, no effect is observed on the implantation and survival of the embryos as compared to the results obtained with transplantation. However, if the transplantation is carried out at some period of time before pregnancy and then the transplant is removed on the day of conception, the number of live embryos increased by 10.3% (with an error of ±4.7%). Thus, the transplantation of healthy ovaries to irradiated rats increases the post-implantation survival of the embryos only if the transplantation is made before pregnancy, and the effect can be observed even if the transplant is removed in the very earliest stages of embryonic development. It is assumed that hormones from the ovaries have a beneficial effect on the survival of the embryos in the post-implantation period. (TTT)

19168 THE ACTION OF RADIATION OF THE ANATOMICAL AND PHYSIOLOGICAL FEATURES OF POTATO EYES. N. P. Korableva (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 454-7(Mar. 11, 1961). (In Russian)

The morphological changes taking place in potato eyes irradiated with a dose of 500 to 10,000 r were correlated with the distribution of RNA and DNA in the tunica, the procambium and the apical meristem of the potato eye. At a dose of 500 to 2000 r the integrity of the cell is upset, and it is observed that RNA diffuses among the various organs. Although thin, elongated shoots are formed, the eye loses its ability to grow and form new tissue after a certain time. The size and shape of the cells vary considerably. After 25 to 30 days of sprouting, the shoot again acquires its normal growth characteristics. At a dose of 8000 to 10,000 r the cells of the potato eye do not divide, but become elongated in length and width. The shape of the eye is very varied because of the degeneration of tissue. The differentiation present in a normal shoot vanishes completely. The cells become the same in size and show large vacuoles. The content of RNA in the cytoplasma decreases sharply. It is concluded that the disturbance in the growth processes of the potato eye by irradiation is closely coupled with changes of RNA and DNA content, especially of the RNA content. (TTT)

19169 MUTAGENIC EFFECT OF METABOLITES IN IRRADIATED PLANTS. A. M. Kuzin and L. M. Kryukova (Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 970-1(Apr. 1, 1961). (In Russian)

Previous work had shown the presence of "antimitotic" substances in irradiated plants that could account for the cessation of cell division in the plant. An attempt was made to detect mutagenic activity on the part of these metabolites by irradiating 12 to 14 day plants of Vicia faba with an x-ray dose of 25,000 r. An extract was prepared from the irradiated plants, and 3 to 4 day rootlets of Vicia faba were placed in this extract for 24 hrs. The rootlet was fixed and stained in order to make an anaphase and telophase count, and a count of the chromosome aberrations (bridges) and of micronuclei. Rootlets grown in water and in an extract of unirradiated plants served as controls. The percent of chromosome aberrations based on the number of anaphases and telophases observed was 5.3% for the plants grown in the irradiated extract compared to 1.1% for the controls. Thus, it is concluded that there is a stable material formed during irradiation that possesses mutagenic activity. (TTT)

19170 THE BIOSYNTHESIS OF CHLOROPHYLL IN RESERVE DEPOTS OF PLANTS IN CONNECTION WITH THE ACTION OF IONIZING RADIATION. E. N. Mukhin and E. G. Sal'kova (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 976-9 (Apr. 1, 1961). (In Russian)

Potato tubers irradiated with a gamma dose of 10,000 r or higher lose their ability to form chlorophyll. The changes in various oxidation-reduction enzymes were followed in normal potatoes and in potatoes irradiated with doses of 10,000 and 150,000 r. It was observed that the activity of peroxidase in the control potatoes rose to a higher level than in the irradiated potatoes, when exposed to light. Neither irradiation nor exposure of the tuber to light caused an increase in the activity of polyphenol oxidase. Glycolic acid oxidase increases in activity on exposure of the tuber to light, but no change in activity was noted even on irradiating the tuber with a dose of 150,000 r. Hence, the activation of this oxidase may proceed independently of the presence of chlorophyll. The dehydrogenases are more active in the irradiated potato than in the control. Since the level of oxidative enzymes in the irradiated potato is about that of the control while the synthesis of chlorophyll is slowed down by radiation, it is assumed that there is a disruption between the oxidative processes and phosphorylation. The results of a special experiment show that the activity of hexosephosphatase is suppressed in the irradiated potato as compared to the control. The processes of oxidation and phosphorylation are both required for the synthesis of chlorophyll. (TTT)

19171 DESIGN STUDIES FOR A Cs-137 IRRADIATOR. D. O. Cummins and C. F. G. Delaney (Trinity Coll., Dublin). Intern. J Appl. Radiation and Isotopes, 10: 106-11(Apr. 1961). (In English)

Design studies for a 600-c cesium irradiator for genetic experiments are described. The six source rods, arranged in a cylinder around the sample, can be moved in and out on an iris diaphragm arrangement so as to give varying intensities at the sample. The distribution of the discrete sources contained in the rods is discussed in detail, with a view to providing the maximum flux uniformity throughout the sample to be irradiated. A low-activity mock-up was used to arrive at an arrangement which was appreciably better than a uniform distribution of sources along the rods. A twelve rod system is also briefly discussed. (auth)

19172 CHANGES OF THE ENDOCRINE SYSTEM BY RADIATION EFFECTS. L. A. Kashchenko (Central Scientific Research Inst. of Medical Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 2, 65-71(Feb. 1961). (In Russian)

The endocrine glands are sensitive to radiation to a greater or lesser degree and as a general rule behave like other organs and tissues. In case of total irradiation compensating reactions take place presenting a definitely pathological character. Reaction to ionizing radiation consists in a composite effect of a primary direct action and the radiation-generated changes in functionally related organs. The specific behavior of these organs must be established before the over-all effects can be evaluated. The direct effects are usually constant while the compensating reactions depend on the radiation level; the specific reaction of the endocrine system toward irradiation is determined by the joint effect of these two factors. (TTT)

19173 THE RELATIVE MERITS OF THE EXTERNAL GAMMA AND X-RAY IRRADIATIONS (REMARKS TO THE PAPER OF M. S. OVOSHCHINIKOV AND A. M. SEMENOVA PRESENTED AT THE KHARKOV CONFERENCE ON THE MEDICAL AND DIAGNOSTIC APPLICATIONS OF RADIOACTIVE ISOTOPES, HELD ON MAY 25 TO 27, 1960). A. Ya. Berlovskii. Med. Radiol., 6: No. 2, 72-4(Feb. 1961). (In Russian)

Doubt is expressed about the usefulness of external gamma radiation and the opinion is offered that x-ray methods are more effective in cancer therapy. In order to avoid misleading practicing physicians, it is pointed out that the skin effect is more favorable in the case of the high-energy gamma quanta because the secondary electrons generated have a long mean free path preferentially in the forward direction as a result of which the dose will first increase from the surface value to a maximum corresponding to the length of the mean free path, beyond which it will decrease exponentially, resulting in a favorable skin effect. The claim that the deeper maximum will cause subcutaneous fibrosis is not confirmed by the literature data cited. In considering the over-all reaction to radiation, the integrated dose is mistakenly referred to and inclusion in their calculations of the body weight and other personal factors of the patient, which are helpful to calculate the optimum conditions was neglected. Several other physical errors of the original article are pointed out. (TTT)

19174 THE EFFECT OF IONIZING RADIATIONS ON THE ANTIGENIC PROPERTIES OF TISSUES. A. S. Shevlev. Med. Radiol., 6: No. 2, 78-9(Feb. 1961). (In Russian)

Until only recently the effect of ionizing radiations on the antigenic properties of tissues has been studied primarily by means of the reaction of active anaphylaxis with desensitization. This problem was investigated by subjecting white mice to supralethal (3 to 5000 r) doses of gamma and x-ray radiation and studying the precipitation reaction in the gel. The mice were phlebotomized prior to death and after washing the organs in vivo and in vitro with glacial physiological solution, rabbits were immunized with their serum. The animals presented Oucherlon's precipitation reaction in the gel. The serum of the animals immunized with liver tissue had a higher precipitin level against the homologous tissue of irradiated animals than the level of antibody found in the reaction with the liver tissue of normal mice. According to the results the antigenic properties of the tissue may be modified not only in the terminal stages of radiation sickness but even during the first hours after irradiation. (TTT)

19175 CHRONIC EFFECTS OF SMALL DOSES OF X-RAY RADIATION ON THE DESCENDENTS OF DOGS TREATED WITH URANIUM FISSION PRODUCTS. M. S. Lapteva-Popova. Med. Radiol., 6: No. 3, 78-9(Mar. 1961). (In Russian)

In order to gain a better understanding on the effect of radioactive materials in the organism on the impairment of the resistance against ionizing radiations, a group of dogs were treated with 1 mg/kg of uranium fission products, cooled for 1 year. The fission product mixture contained 21.2% Zr^{95}, 62% Ru^{186}, 12.7% Y^{91}, 24.1% Sr^{90}, 2.6% Ce^{144}, 1.5% Ba^{140} and 16.3% Nb^{95}. The offspring of these dogs were exposed to daily doses of 10 r of x rays, using a similar group of healthy dogs as control. Irradiation of the control group caused radiation sickness, interfering greatly with hemopoiesis. After a total dose of 780 to 1320 r, the leucocyte, thrombocyte and reticulocyte content of the blood was lowered but this was followed by a period of noticeable improvement, as shown by blood and bone marrow indices. In the second group the leucocyte content was continually lowered, and after 750 to 1000 r of integrated dose there were signs of hypoplasia of the bone marrow. The average life of the animals of this group was $6\frac{1}{2}$ months; that of the control group $2\frac{1}{2}$ years. Treatment of the parents with fission products thus greatly reduced the resistance of the offspring against ionizing radiation. (TTT)

19176 RADIATION CARCINOGENESIS AT HIGH DOSE-RESPONSE LEVELS: A HYPOTHESIS. Arnold E. Reif (Tufts Univ. School of Medicine, Boston). Nature, 190: 415-17(Apr. 29, 1961).

It is postulated that carcinogenesis and cytotoxicity induced by radiation act in opposition and together produce the over-all relationship between radiation dose and tumor incidence that is found experimentally. The carcinogenic-cytotoxic potencies for Ra, Sr^{90}, and Ca^{45} were calculated. Applications of the determinations of optimum tumor dose are discussed. (C.H.)

19177 SURVIVAL OF SKIN HOMOGRAFTS IN RADIATION CHIMERAS. Sergio Poimelli, Doughlas M. Behrendt, John F. O'Connor, and Joseph E. Murray (Peter Bent Brigham Hospital, Boston and Harvard Medical School, Boston). Transplantation Bull., 27: 431-6(Apr. 1961).

Homologous rabbit radiation chimeras accept skin homografts from donors unrelated to both recipient and marrow donor if placed immediately after irradiation; they reject in a normal way skin homografts placed six months later. Secondary transplantation immunity in homologous rabbit radiation chimeras is maintained, although delayed when either the recipient or the marrow donor is pre-sensitized. Irradiated rabbits protected with autologous marrow reject skin homografts after considerable delay. C57L mouse isologous radiation chimeras retain for a considerable time

skin from C57BL/6 mice (same H-2 locus) but reject skin from C3H (different H-2 locus) if these grafts are placed immediately after irradiation. The prolongation of the C57BL/6 skin grafts is less marked if the grafts are applied 17 days later or if 400 r is given without marrow support. The above findings might possibly be interpreted as a result of acquired tolerance by the donor marrow. As a consequence, secondary disease does not result from transplantation immunity, but rather from circulating-type antibodies produced by the grafted marrow. (auth)

19178 HOMOGRAFTS ON ISOLOGOUS AND HOMOLOGOUS RADIATION MOUSE CHIMERAS. Sheila M. A. Doak and P. C. Koller (Chester Beatty Research Inst., London). Transplantation Bull., 27: 444-7(Apr. 1961).

Results are reported from experiments in which attempts were made to assess general immunological function by following the rejection of grafts which are homografts to either host or donor or to both. The results show that immunological function in isologous chimeras is fully restored in 25 to 50 days, but that many homologous chimeras have a general immunological impairment. Homologous donor cells, however, even when derived from a tissue containing few lymphoid blast cells, may quickly develop antihost activity. (auth)

19179 TESTS ON THE TOLERANCE-INDUCING POWER OF LETHALLY IRRADIATED SPLEEN CELLS. J. G. Howard and Donald Michie (Univ. of Edinburgh). Transplantation Bull., 27: 455-7(Apr. 1961).

Irradiated homologous spleen cells induced a transient state of tolerance to skin homografts when injected into newborn mice. Results of two experiments are reported. It was concluded that a given number of irradiated cells, even if fully antigenic, represent a smaller effective dose than the same number of living cells, due to the ability of the latter to multiply. (C.H.)

19180 ROTATION TELEGAMMATHERAPY OF INOPERABLE CANCER OF THE LUNG. I. I. Kornev (Ministry of Public Health, RSFSR). Vestnik Rentgenol. i Radiol., 36: No. 1, 33-6(Jan.-Feb. 1961). (In Russian)

Rotation telegammatherapy (GUT Co—400 unit) was applied to 70 patients with pulmonary cancer. Radiation treatment lasted for a period of 3 to 5 weeks with a daily focal dose of 200 to 250 r. The sum total focal dose averaged 7,000 to 8,000 r. The death has occurred to 48 of the patients within the period of 2.5 years after initiation of the treatment (13 of these in less than 6 months, 27 in a year, and 8 in a year and a half). At present 22 patients are still alive and in a satisfactory condition (4 of these are being observed for less than 1.5 years, 10 for 1.5 to 2 years and 8 for a period of 2 years). This treatment was tolerated well, without any marked general radiation reaction. In two thirds of the patients no skin reactions were noted. Radiation reaction was observed in the pulmonary tissue in 29 of the cases; the reactions, however, developed only in the zone of the affected lung tissue without leading to rough fibrosis. (auth)

19181 EXCRETION FROM THE BODY IN TREATMENT OF ERYTHREMIAS WITH RADIOPHOSPHORUS. A. L. Kozyreva (Central Inst. for Improvement of Physicians). Vestnik Rentgenol. i Radiol., 36: No. 1, 40-4(Jan.-Feb. 1961). (In Russian)

26 erythremic patients subjected to radiophosphorus treatment with the doses ranging from 4 to 12 mc. P^{32} was found to be effective in treatment of this disease. There was complete remission noted in 21 patients and improvement in 5 cases. Radioactivity of urine and feces was investigated throughout the curative procedures. As shown, kidneys were the main organ excreting P^{32} after per os administration. It could be detected in the urine for a long space of time. Within 6 days 30 to 45% of the therapeutic dose is excreted by the kidneys and intestines. The greatest daily proportion of renal excretion equals 10% and it is observed during the first 24 hours. (auth)

19182 OSSEOUS CHANGES IN CHRONIC EXTERNAL IRRADIATION. A. V. Grinberg and T. V. Orlova (State Scientific Research Inst. for Labor Hygiene and Professional Diseases, Leningrad). Vestnik Rentgenol. i Radiol., 36: No. 2, 10-14(Mar.-Apr. 1961). (In Russian)

Demonstrable osteodystrophic changes were detected in the skeletal bones of roentgenologists, radiographists, physicists, radiologists and other persons subject to the action of ionizing radiation. Radiation affections are characterized by osteoporosis, the presence of areas of resorption and osteosclerosis, bone atrophy, bone structure readjustment and by progressively increasing changes in a distal direction. In some instances radiation changes in the bones occur in persons with normal uninjured skin, and this is to be taken account of during periodic medical examinations of individuals belonging to the above professional groups. (auth)

19183 THE RISK OF LEUKEMIA IN MAN FOLLOWING RADIATION EXPOSURE. Robert M. Heyssel (Vanderbilt Univ., Nashville) and Bertrand Brill. p.266-81 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Accumulated data are reviewed on the incidence of leukemia following radiation exposure. Data are included on the incidence of leukemia in Japanese atomic bomb survivors at Hiroshima and Nagasaki. It is concluded that all age groups may develop leukemia after radiation exposure, with the younger ages probably the most susceptible; dose-response relationships have not been directly quantitated in humans below 50 to 100 rads; the incidence of leukemia is doubled at doses in the neighborhood of 50 to 100 rads; and the time of continued risk following exposure is at least 13 yr. (C.H.)

19184 A REVIEW OF THE TUMOR INCIDENCE IN CHILDREN IRRADIATED FOR BENIGN CONDITIONS. Robert W. Murray and Louis H. Hempelmann (Univ of Rochester School of Medicine and Dentistry, N. Y.). p.282-93 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

A survey on children treated for benign conditions with x rays showed a higher incidence of neoplasis. (C.H.)

Radiation Sickness

19185 (CEA-1841) ETUDE DES PROPRIETES ANTIHYDROIDIENNES ET RADIOPROTECTRICES DE COMPOSES DE LA FAMILLE DES 5 THIONE IMIDAZOLIDINES. (Study of the Antithyroid and Radioprotective Properties of Compounds of the 5 Thione Imidazolidine Group). R. Rinaldi and Y. Bernard (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Jan. 27, 1961. 14p.

Some compounds of the 5 thione imidazolidine group were synthesized. Certain pharmacodynamic properties which these substances may be expected to show on the basis of their structure were studied. The properties looked for include antithyroid activity, determined by studying the difference in iodine-131 fixation by the thyroid of treated and untreated rats, and radioprotective activity, determined by the comparative study of percentage survival after 30 days

of mice subjected to a lethal dose of x radiation and having received or not, before irradiation, an intraperitoneal injection of the product under investigation. (auth)

19186 THE STATE OF THE PERIPHERAL BLOOD AND BONE MARROW IN TELEGAMMATHERAPY OF PATIENTS WITH CANCER OF THE ESOPHAGUS. Sh. M. Beibutov (Azerbaidzhan Roentgeno-Radiological Scientific Research Inst., USSR). Med. Radiol., 6: No. 2, 7-11(Feb. 1961). (In Russian)

A study was made of the peripheral blood and bone marrow in patients suffering from carcinoma of the esophagus who were subjected to telegammatherapy on the GUT-Co-400 apparatus (total doses of 8,000–21,000 r on the skin). It has been ascertained that telegammatherapy does not exert any noticeable influence on the erythrocyte count and hemoglobin content in the peripheral blood. The medullary hematopoiesis became inhibited in areas of the skeleton subjected to direct massive irradiation. No essential changes were found in distant parts of the bone marrow. (auth)

19187 CHANGES IN THE BONE MARROW OF PATIENTS WITH CANCER DURING ROENTGEN THERAPY. L. Telcharov, K. Vlakhov, T. Marovski, and M. Karparov (Pavlov Inst. of Higher Medicine, Plovdiv, Bulgaria). Med. Radiol., 6: No. 2, 11-16(Feb. 1961). (In Russian)

Studies were made of the morphological composition of the bone marrow of the ilium in patients suffering from cancer of the mammary gland and sternum, as well as in cancer of the uterine cervix. Changes of the serum protein fractions and the morphology of the peripheral blood were also assessed. (auth)

19188 BASAL METABOLISM AND MORPHOLOGICAL COMPOSITION OF THE PERIPHERAL BLOOD IN RADIOIODINE THERAPY OF THYROTOXICOSIS. I. D. Kucherova (Central Scientific Research Inst. of Medical Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 2, 16-22(Feb. 1961). (In Russian)

Studies of the basal metabolism and morphological composition of the peripheral blood carried out in 104 patients suffering from thyrotoxicosis of varying severity are reported. The basal metabolism, which as a rule is augmented, is one of the important indices of the severity of the disease. (auth)

19189 THE PROPERDIN SYSTEM AND CHANGES THEREIN IN RADIATION SICKNESS. V. D. Gekker, A. P. Konikov, L. K. Ivanova, and I. A. Tarkhanova (Gamalei Inst. of Epidemology and Microbiology, Academy of Medical Sciences, USSR). Med. Radiol., 6: No. 2, 22-7(Feb. 1961). (In Russian)

A simplified method of properdin titration without R-reagents was used. It permits repeated regular results. During irradiation the properdin level in rats and rabbits decreases. The dynamics of properdin level changes in the blood of the irradiated animal could be of prognostic importance. Along with the properdin titer decline during irradiation, the titer of normal Flexner dysentery antibodies also diminishes. (auth)

19190 RESTORATION OF HEMATOPOIESIS IN RABBITS IN VARYING SEVERITY OF ACUTE RADIATION SICKNESS. V. V. Sokolov. Med. Radiol., 6: No. 2, 27-32 (Feb. 1961). (In Russian)

The restoration of hematopoiesis was studied in 150 rabbits. The animals were subjected to x irradiation in doses of 200, 600, 800, and 1,800 r. The centers of hematopoiesis and peripheral blood were investigated before the irradiation and on the 1st, 3rd, 5th, 7th, 10th, 12th, 15th, 20th, 30th, 40th, and 50th day following it. The data obtained testify to the fact that in severe, moderate, and mild lesions the restoration takes place simultaneously in the white and red marrow, with a certain prevalence in the first days of the somewhat atypical regeneration of granulopoiesis. Subsequently the bone marrow produces predominantly erythroblasts, then the granulopoiesis activation begins at a later date following irradiation, on the 15th to 20th day. Elements of regeneration could be observed in rabbits even in absolutely lethal lesions. The appearance and markedness of regeneration of thrombopoiesis and lymphopoiesis is also closely connected with the severity of affection. The restoration of thrombopoiesis coincides with manifestations of regeneration in the erythrocytic series of the bone marrow. (auth)

19191 ON THE RESPIRATORY FUNCTION OF THE BLOOD IN DOGS AFFECTED WITH RADIATION SICKNESS. M. D. Draguzya (Kirov Military Medicine Academy, USSR). Med. Radiol., 6: No. 2, 32-7(Feb. 1961). (In Russian)

Studies are presented of gases of the arterial and venous blood, the hemoglobin content, the curves of dissociation of oxyhemoglobin and carbon dioxide, inactive derivatives of hemoglobin, and the degree of oxygen saturation of the arterial blood. (auth)

19192 CHANGES OF THE CIRCULATING BLOOD VOLUME IN DOGS WITH ACUTE RADIATION SICKNESS. N. V. Butomo (Kirov Military Medicine Academy, USSR). Med. Radiol., 6: No. 2, 37-40(Feb. 1961). (In Russian)

The experiments were staged on dogs. Under investigation were changes occurring in the volume of the circulating blood during acute radiation sickness. (auth)

19193 THE CARDIAC OUTPUT AND PERIPHERAL RESISTANCE IN ACUTE RADIATION SICKNESS. V. I. Kuznetsov (Kirov Military Medicine Academy, USSR). Med. Radiol., 6: No. 2, 40-6(Feb. 1961). (In Russian)

A graphic determination was made of certain hemodynamic indices of dogs in acute radiation sickness. It has been divulged that the systolic (minute) blood volume drops considerably and the peripheral resistance increases. A drop of the erythrocyte and hemoglobin content in acute radiation sickness, in contradistinction to anemias of other etiology, does not lead to a rise of the minute volume of the blood. (auth)

19194 THE ROLE OF MAGNESIUM COMPOUNDS IN THE EXPERIMENTALLY INDUCED RADIATION SICKNESS. V. Mikhailov and A. Bozduganov. Med. Radiol., 6: No. 2, 75-6(Feb. 1961). (In Russian)

Parenteral introduction of Mg exerts a soothing, anticonvulsive, and slightly narcotic effect, being similar in its action on the motor nerves to that of curare; therefore it was deemed of interest to study its influence on the radiation syndrome. For this purpose groups of white rats were injected at various times before or after irradiation with a 10% physiological $MgSO_4$ solution. Injection of the animals before exposure to x rays showed some protective action at lethal dose levels while injection after irradiation did not show such an effect. This behavior is attributed to the effect exerted by the Mg compound on the nervous and the reticular endothelial systems. (TTT)

19195 PROTECTIVE EFFECT OF S- AND N, S- SUBSTITUTED β-MERCAPTOETHYLAMINE UNDER THE INFLUENCE OF IONIZING RADIATION ON THE LIVING ORGANISM. L. I. Tank. Med. Radiol., 6: No. 2, 76-7(Feb. 1961). (In Russian)

On the basis of previous findings it is assumed that the S- and N, S-substituted β-mercaptoethylamine derivatives,

which are more stable than the original compounds outside of the organism in view of the blocking action of the mercapto radical, may lose their blocking group within the organism thus becoming a mercaptoamine with protective properties against radiation. Their increased stability would make such compounds more convenient to use. For this purpose 13 S- and 9 N,S-substituted compounds were prepared, injecting them intraperitoneally in white mice which were subsequently exposed to lethal dose levels of x radiation. It was found that the S-methyl, S-phenyl, S-benzimidazolyl, S-thiazolyl, and S-furfuryl β-mercaptoethylamine exhibited a marked protective action, preventing the death of 4 to 6 animals from 10 irradiated ones. (TTT)

19196 THE MECHANISM OF THE PROTECTIVE ACTION BY SHIELDING THE ORGANS DURING THE TOTAL IRRADIATION OF RATS. N. N. Klemparskaya. Med. Radiol., 6: No. 2, 77-8(Feb. 1961). (In Russian)

The effectiveness of shielding portions of the body during total body irradiation has been established previously when it was noticed the survival rate increases considerably upon shielding the spleen, kidney, intestines, or the appendix of the test animals. In order to study the mechanism involved, the spleen of male mice exposed to 500 r total body x-ray dose was protected by removing it from the body and placing it in a Pb shield; in a similar series the shield was omitted. In another series the rear feet and the tail of the animals were shielded. In both cases the rate of survival was increased threefold. Making cytolysin determinations on the various animals it was found that whenever the spleen or the bone marrow (limbs or tail) were protected during the irradiation, the leucolysin production was reduced, probably because the shielding reduces the number of cells directly injured by the radiation resulting in a reduced rate of formation of the decomposition products which exert an autoimmunizing action. (TTT)

19197 THE EFFECT OF THE "ANEMIC PLASMA" FACTOR IN THE ERYTHROPOIESIS OF IRRADIATED DOGS. L. L. Shepshelevich and L. S. Rogacheva. Med. Radiol., 6: No. 2, 79-81(Feb. 1961). (In Russian)

An attempt was made to stimulate the formation of blood in dogs exposed to various levels of irradiation by x rays ranging from 600 to 150 r. Nine of the 17 dogs used were injected with the albumin-free seric extract of repeatedly phlebotomized animals while the others served as controls. The degree of erythropoiesis was determined by incorporating Fe^{59} in the erythrocytes. Results indicated that introduction of these extracts does not exert a positive influence on the process in dogs exposed to 300 to 600 r but it increased the erythropoiesis in animals irradiated with only 150 r. (TTT)

19198 COMPOSITION OF THE PERIPHERAL BLOOD OF PRENATALLY IRRADIATED WHITE RATS. M. B. Gol'dberg. Med. Radiol., 6: No. 2, 81-2(Feb. 1961). (In Russian)

To establish the changes induced by ionizing radiation on the composition of peripheral white rat embryos, the animals were subjected to whole-body x-ray radiation of 200 r at various stages of their pregnancy which resulted in leucopenia within 24 hours. The blood of the prenatally irradiated animals was analyzed at various periods ranging from 1 to 30 days after birth for hemoglobin, erythrocytes and leucocytes. The results indicated a sharp change when the irradiation took place on the 18th day of the intrauterine development: at birth, 5 days later, and for a period afterward the animals show symptoms of radiation sickness including diarrhea, leucopenia and anemia. Irradiation before the 18th day of pregnancy seems to affect the mother; after that period it interferes directly with the blood-forming organs. (TTT)

19199 THE CHLORIDE CONTENT OF THE BLOOD OF MACAQUE RHESUS MONKEYS DURING IRRADIATION. L. I. Polikarpova and A. Ya. Shulyatikova (Inst. of Experimental Pathology Therapy, Academy of Medical Sciences, Moscow). Med. Radiol. 6: No. 3, 79-80(Mar. 1961). (In Russian)

The change of the Cl^- concentration of the blood of Rhesus monkeys exposed to a massive single dose of 700 r of x rays was followed, making determinations 3 times before the irradiation and on the 1st, 3rd, 5th, 6th and 8th day after the test. The animals died 7 to 10 days after irradiation. From the data it is concluded that irradiation with a lethal dose causes a definite destruction of the chloride metabolism. In some cases the Cl^- content of the blood increased sharply, falling below average 5 to 8 days after irradiation. The shift of the Cl^- concentration shows that the electrolytic composition of the blood is radically altered. (TTT)

CHEMISTRY

General and Miscellaneous

19200 (BNL-5314) CORRELATION OF TRITIUM AND DEUTERIUM ISOTOPE EFFECTS. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract AT(30-2)-Gen-16. 16p.

The theory of relative tritium-hydrogen and deuterium-hydrogen isotope effects is developed for both rate and equilibrium processes. It is shown that the relative effects in equilibrium processes vary with the strength of the chemical bonding and the temperature. A lower limit of 1.33 and an upper limit of 1.55 is established for $\ln \alpha_{T-H} / \ln \alpha_{D-H}$. Detailed calculations are given for a number of simple molecules. It is shown that the temperature independent frequency factor in rate processes increases the ratio $\ln(k_H/k_T)/\ln(k_H/k_D)$ above the values found in equilibrium processes. Equations are given from which the increment can be calculated. It is shown that relative tritium-protium versus deuterium-protium isotope effects may be of diagnostic use in characterizing secondary isotope effects and tunnelling in chemical reactions. Detailed calculations are given for processes involving water including equilibration with hydrogen, distillation, and electrolysis. In these processes, α_{D-H} varies from 5×10^{-2} to 10, yet $\ln(\alpha_{T-H})/\ln(\alpha_{D-H})$ is calculated to be in the range 1.33 to 1.40 for all three processes. (auth)

19201 (CF-61-3-94) ADSORPTION OF URANIUM ON HYDROUS ZIRCONIUM OXIDE FROM URANYL SULFATE SOLUTIONS AT ELEVATED TEMPERATURES. J. C. Banter and S. H. Wheeler (Oak Ridge National Lab., Tenn.). Mar. 1, 1961. 26p.

Measurements of the adsorptive capacity of hydrous zirconium oxide for uranium from uranyl sulfate solutions at high temperature (250°C) were made to characterize the effects of certain system variables on the uranium adsorption process. Techniques employed included simple batch-type experiments in which small amounts of oxide were equilibrated with UO_2SO_4 solutions and modified breakthrough experiments with a special high-temperature ion-exchange column. Reproducibility of the results of the column experiments was poor, and little quantitative information was gained from them. The batch-type experiments indicated a dependence of the uranium adsorption at 250°C given by $U_A = 30.2C^{0.4}$ where U_A is the amount of adsorbed uranium in mg per g of oxide, and C is the solution concentration in mg per ml at 25°C. (auth)

19202 (HW-67564) CATION EFFECTS ON THE DISTRIBUTION OF URANIUM IN THE SYSTEM: ALUMINUM-ALUMINUM CHLORIDE-ALKALI CHLORIDE. R. H. Moore (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 28, 1960. Contract AT(45-1)-1350. 19p.

The distribution of uranium in the $NaCl-AlCl_3-Al$, $CsCl-AlCl_3-Al$, $NaCl-KCl-AlCl_3-Al$, and $LiCl-KCl-AlCl_3-Al$ systems was studied as a function of the composition of the salt phase for each of these systems. Results indicated that the alkali chlorides differ markedly in their effects on uranium distribution. These differences were considered to be due to differences in the polarizing power of the cation. The distribution of uranium in systems of the type $MCl-AlCl_3-Al$ increasingly favored the metal phase as the size of the cation increased. The distribution in the $KCl-AlCl_3-Al$ system was not affected by substitution of up to 60 wt.% of the KCl by LiCl or NaCl. The distribution of uranium was found to be strongly dependent on the composition. The distributions exhibited a maximum at aluminum chloride to alkali chloride mole ratios of 1.0. (M.C.G.)

19203 (HW-68380) REACTIONS OF GRAPHITE WITH MICROWAVE-ACTIVATED NITROGEN; PRELIMINARY REPORT. R. C. Giberson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 14p.

The reaction of graphite with microwave-activated nitrogen gas was studied. The principal product of the reaction was paracyanogen which was found to plate out on the cooler quartz walls of the reaction vessel. Weight loss rates from the graphite samples were of the magnitude of 10^{-4} to 10^{-5} grams/gram-hour. (auth)

19204 (IDO-14543) BASIC STUDIES OF CHEMICAL STABILITY IN EXTRACTION SYSTEMS. I. THE EFFECT OF ZIRCONIUM NITRATE AND NITRIC ACID UPON THE CHEMICAL STABILITY OF TRIBUTYL PHOSPHATE. A. J. Moffat and R. D. Thompson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 14, 1961. 18p.

The effect of extracted zirconium and nitric acid upon the chemical stability of tributyl phosphate was investigated using gas-liquid chromatography. Tributyl phosphate was degraded approximately 1000 times faster by the tributyl phosphate-zirconium reaction than by the tributyl phosphate-nitric acid reaction. Normal butyl nitrate was the major volatile product for both systems studied; with extracted zirconium a solid complex corresponding to the formula $Zr(NO_3)_2(DBP)_2$ was also obtained. (auth)

19205 (IS-192) ANNUAL SUMMARY RESEARCH REPORT IN CHEMISTRY, JULY 1, 1959–JUNE 30, 1960. (Ames Lab., Ames, Iowa). Sept. 1960. Contract W-7405-eng-82. 119p.

Pilot-plant work on ion exchange separation of rare earths indicates that elution with HEDTA on hydrogen-form resin should conserve Sc. Then, after Sc, Lu, Yb, Tm, and Er are diverted to an auxiliary bed, the remaining rare earths can be resolved with EDTA. Data from investigations of rare-earth glycolate solubilities at 20 and 60°C are tabulated. In other work, the effectiveness of glycolic acid for fractionally precipitating rare earths was investigated, and the solubilities and composition rare-earth nitrilotriacetates were studied. Data on preparation of Y are given and information on physical, mechanical, and thermal properties of rare-earths is presented. Corrosion of Zr–Sc alloys in high temperature water was studied and data on the physical properties of rare-earth salts obtained during the report period are given. Preliminary results on the mass spectra of group IV-B and V-B elements are presented. Synthetic methods for preparing highly pure $VOCl_3$ and VOF_3 are reported. Results of studies on the fragmentation of N^{29} molecule indicate that more $^{15}N^+$ ions than $^{14}N^+$ are produced by electron bombardment at 45 to 100 volts. A wet chemical procedure for N in metals and alloys by isotope dilution with an average precision of ±5% is reported. A study in which oxygen isotopes are quantitatively released by $KBrF_4$ from inorganic compounds and determined by isotopic dilution is described. Results of investigations of oxygen isotopes in boron minerals found in the Kramer Ore Body at various levels are tabulated. Methods for isotopic assay of C and N, O and N, Si and O, and B and

O in compounds are described. Research on the cohesion in polyatomic many-electron systems and on the nature of chemicals is reported from which it is concluded that the chemical bond owes its existence to a lowering of the kinetic energy in the bond region which creates the possibility of a closer approach of the valence electrons to the nuclei with a concomitant lowering of the potential energy. Pyrometallurgy. Data on distribution of rare-earths between Mg–Ag and Cl–Cr phases obtained by radiochemical techniques are presented for Nd, Sm, and Tb. In other work, vapor pressure measurements by the Knudsen method were found unsatisfactory for Zn. A dew point method was used for Zn–Mg and Zn–Al systems. Analytical Chemistry. A high-temperature fluorination apparatus for determining in metals and salts was developed which has a precision of ±2%. Investigation of organophosphorus compounds for metals was continued with the emphasis on bis-(di-n-hexylphosphinyl) methane. Properties of this compound are tabulated along with data on the extraction of various metals by its use. In differential spectrometry it was found that proper use of a relative method in which the sample absorbance is compared with the absorbance of a known reference can result in an appreciable increase in precision and accuracy. Analytical procedure developments are given for Ce, Al, Cr, Zn, Cu, In, Mg, Th, W, U, Mo, Ta, and Zr. Spectrometric techniques are reported for O determination in metal halides. Spark emission spectra for all rare earths except Ce were observed and an x-ray-fluorescent method for Sc in ores is reported. Radiochemistry. The cross sections of the $Ar^{40}(\gamma,p)Cl^{39}$, and $Ar^{40}(\gamma,pn)Cl^{38}$ reactions as a function of photon energy were determined. In experiments with the acid hydrolysis of trans $[Pt(NH_3)_2Cl_2]$ a first acid hydrolysis with the equilibrium constant of 3.6×10^{-4} moles/l at 25°C and a rate constant of 9.8×10^{-6} sec^{-1} was observed. Crystal structure investigations of dimethyl zinc $LiCuCl_2 \cdot 2H_2O$, bis-metabromobenzoylmethane, and $CrCl_2$ are reported. Completion and testing of a high-precision electron unit and initiation of molecular structure studies are described. (J.R.D.)

19206 (IS-293) CHLOROTRIAMMINEPLATINUM(II) ION. ACID HYDROLYSIS AND ISOTOPIC EXCHANGE OF CHLORIDE LIGAND. Ferruccio Aprile and Don S. Martin, Jr. (Ames Lab., Ames, Iowa). May 15, 1961. 14p.

The acid hydrolysis of $[Pt(NH_3)_3Cl]^+$ was shown to occur to a measurable extent in the reaction $[Pt(NH_3)_3Cl]^+ + H_2O \underset{k_1}{\overset{k_{-1}}{\rightleftharpoons}} [Pt(NH_3)_3(H_2O)]^{++} + Cl^-$; the equilibrium quotient was measured at 25°C and 35°C. At 25°C this quotient was 8.4×10^{-5} at μ (ionic strength) = 0 and 25×10^{-5} at μ = .318M. This variation is consistent with the expected changes in activity coefficients. $\Delta H°$ for the reaction was found to be approximately 0. The rate constant, k_1 was 2.3×10^{-5} sec^{-1} at 25°C and it was nearly independent of ionic strength. The acid hydrolysis provides a mechanism for the exchange of the chloride ligand and Cl^-. Exchange experiments with Cl^{36} showed that in addition to the acid hydrolysis, a process, first order in both, $[Pt(NH_3)_3Cl]^+$ and Cl^- with a rate constant of 6×10^{-5} sec^{-1} M^{-1} contributes to the exchange. The behavior of the entire series of chloro-ammines of platinum(II) toward acid hydrolysis and chloride exchange was summarized, and a likely mechanism for the processes was discussed. (auth)

19207 (KAPL-M-SLJ-3) THE STABILITY OF ZIRCALOY POWDER IN AIR. S. L. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 30, 1961. Contract W-31-109-Eng-52. 7p.

Zircaloy powder has been proposed as a standard substance for the comparison of oxygen analyses from different laboratories. A study of Zircaloy-2 powder shows that the powder may gain weight in humid air and, for best weight constancy, should be stored in a cool desiccator. (D.L.C.)

19208 (LAR-53) INVESTIGATION OF HYDRIDING CHARACTERISTICS OF INTERMETALLIC COMPOUNDS. Second Quarterly Report, January 1, 1961 to March 31, 1961. (Denver. Univ. Denver Research Inst.). Apr. 25, 1961. Contract AT(33-3)-3. 27p.

The hydriding characteristics of 100 intermetallic phases are presented. Of these, 55 were found to be inert to H at elevated temperatures, 37 were shown to decompose into two other stable phases (at least one of which was a hydride), and the remaining 8 compounds were shown to be intrinsic hydride formers. A discussion of the probable hydriding mechanisms utilized by the intrinsic hydride formers is presented. Experimental evidence also is presented which shows that the observed dissociation of Y_3Al_2 into yttrium hydride and YAl_2 occurs only after Y_3Al_2 absorbs some 25 at.% H. This suggests that Y_3Al_2 and many of the other compounds observed to dissociate in H may possess all of the qualifications of an intrinsic hydride former, but that these hydrides are thermodynamically less stable than the observed dissociation products. A theoretical discussion of the effective atomic size and bonding mechanism for H in various pure-metal hydrides is included. (auth)

19209 (NAA-SR-Memo-5921) HIGH TEMPERATURE REACTION KINETICS OF THE U–Zr–C SYSTEM. P. E. Elkins and B. A. Webb (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1960. 12p.

A preliminary study was conducted on the system U–Zr–C utilizing UC-Zr and UC_2-Zr diffusion couples heat treated at 1200°C under pressure. An attempt was made to correlate the phases formed in the diffusion couples to the ternary phase diagram. A tentative isotherm at 1200°C was constructed for the U–Zr–C system. Qualitative results show extensive reduction of UC by Zr at 1200°C in 2 hr and a less extensive reaction between UC_2 and Zr under the same conditions. (auth)

19210 (NYO-8779) DITHIO- AND SELENOTHIOPHOSPHORUS COMPOUNDS AND THEIR COMPLEXES WITH NICKEL. Dimitrios Karipides and W. Conrad Fernelius (Pennsylvania State Univ., University Park. Coll. of Chemistry and Physics). Apr. 1961. Contract AT(30-1)-907. 10p.

The nickel derivatives of p-$ClC_6H_4(C_2H_5O)PS_2H$, p-$CH_3OC_6H_4(C_2H_5O)PS_2H$ and $(C_6H_5)_2PSSeH$ were prepared and characterized. The dipyridine and di-γ-picoline addition compounds of the above nickel derivatives were prepared as well as those of $(CH_3O)_2PS_2H$, $(C_2H_5O)_2PS_2H$, $C_6H_5(C_2H_5O)PS_2H$, and $(C_6H_5)_2PS_2H$. Attempts to prepare addition compounds with α-picoline were unsuccessful as were efforts to separate the simple nickel derivatives of the unsymmetrically substituted dithio compounds into isomeric forms. (auth)

19211 (ORNL-3127) REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1961. (Oak Ridge National Lab., Tenn.). May 12, 1961. Contract W-7405-eng-26. 187p.

High-Temperature Phase Equilibrium Studies. Studies of fluoride systems suitable for use as reactor fuels are reported. Preliminary studies were carried out on LiF–BeF_2–ZrF_4–ThF_4–UF_4; the results indicate that 5 mole % ZrF_4 concentration has a beneficial effect on the liquidus

temperature over the region of possible use as Molten Salt Reactor Experiment fuel. In studies of the CrF_2-CrF_3 system, a compound $3CrF_2 \cdot 2CrF_3$ was found and characterized. Crystal properties and structures were determined for the compounds: $NaF \cdot BeF_2 \cdot 3ThF_4$, $NaF \cdot BeF_2 \cdot 3UF_4$, $LiSbF_6$, and $LiBrO_3$. Precipitation of Oxides from Molten Fluorides. Studies of oxide precipitation in the system $LiF-BeF_2-ZrF_4-ThF_4-UF_4$ by BeO addition showed that a Zr/U ratio of more than 3.0 results in ZrO_2 precipitation without UO_2 contamination, a ratio of 1.5 results in ZrO_2-UO_2 coprecipitation, and a ratio of 1.0 results in UO_2 precipitation. Addition of sufficient BeO to precipitate all the U and Zr did not precipitate any ThO_2. It is shown that U or Pa can be removed from $LiF-BeF_2-ThF_4$ by addition of small amounts of solid BeO or ThO_2 and that Pa can be precipitated in the presence of 1000 to 2000 ppm U. Solubility of Gases in Molten Salts. The solubility of BF_3 gas in $LiF-BeF_2-ZrF_4-ThF_4-UF_4$ was determined at 500 to 700°C; the measured solubilities at 500 and 700°C were 0.267 and 0.035 mole BF_3 per liter of salt per atm pressure, respectively. The enthalpy of solution was calculated to be −15.1 kcal/mole. Irreversible sorption of BF_3 on graphite was studied; a mean residual content of only 10 ppm B was found which was independent of exposure temperature and BF_3 pressure. The solubility of HF in the same molten fluoride mixture was determined to be 17.0×10^{-6} and 8.0×10^{-6} mole HF per cc salt per atm pressure at 500 and 700°C, respectively; the enthalpy of solution was calculated to be −5.65 kcal/mole. Xenon Poisoning in Molten-Salt Reactors Containing Graphite. The parameters likely to affect the seriousness of xenon poisoning in the Molten-Salt Reactor Experiment were reviewed. The effects of various combinations of xenon generation, burnout, decay, removal by helium stripping, and diffusion into graphite were calculated and related to the graphite porosity, permeability, and xenon diffusion coefficient. Incorporation of a facility to permit stripping of a large fraction dissolved rapidly with half lives of 0.5 to 2.5 min. Experiments made with 2 M $Th(NO_3)_4$ solutions containing a trace of Pa^{233} showed that Pa was precipitated almost quantitatively by H_2O_2 when added in a quantity sufficient to precipitate 2% of the Th. The activation energy for peroxide decomposition in 2 M $Th(NO_3)_4$ solutions was determined to be 22 ± 2 kcal/mole, close to that for uranium solutions; however, the acidity was found to increase the reaction rate, which is contrary to experience with uranium systems. In a solution 2 M in $Th(NO_3)_4$, 2 M in HNO_3, and 75 ppm in U, U was found to remain in solution when a portion of Th was precipitated, and Pa could be removed in the presence of this amount of U. It was found that Pa could be recovered from the salt system $LiF-BeF_2-ThF_4-UF_4-UO_2$ by a process which includes extraction of Pa by Be or Th oxides, conversion into a partially water-soluble system, and extraction by diisobutyl carbinol. The Pa is then removed from the organic phase by stripping with 18 N H_2SO_4. The solubilities of H_2 in H_2O and of D_2 in D_2O were determined at 25 to 250°C. The peroxy salts precipitated from solutions of thorium salts by H_2O_2, with and without added acid, were found in every case to contain the original anion. The stoichiometry is very nearly $Th_2(OO)_3(A^{n-}) \cdot xH_2O$. The temperature dependence of peroxide decomposition catalyzed by Fe showed an anomaly over the range 190 to 210°C which is interpreted to be due to iron inactivation by hydrolytic processes. Uranium(VI) Hydrolysis at Elevated Temperatures. A study of uranyl ion hydrolysis at 25 and 94°C indicates that the principal hydrolysis steps are $UO_2^{2+} + H_2O \rightleftharpoons UO_2OH^+ + H^+$ and $2UO_2^{2+} + H_2O \rightleftharpoons U_2O_5^{2+} + 2H^+$. Equilibrium constants were calculated and the enthalpy, free energy, and entropy of each reaction estimated. The reaction $3UO_2^{2+} + 5H_2O \rightleftharpoons (UO_2)_3(OH)_5^+ + 5H^+$ at higher hydrolysis numbers is also indicated. Isopiestic Studies at Elevated Temperatures. The osmotic coefficients of LiCl, KCl, CsCl, Na_2SO_4, $BaCl_2$, $MgSO_4$, and UO_2SO_4 were measured relative to NaCl at 100 to 142°C. The osmotic coefficients for 1-1 electrolytes at 121.1°C showed a concentration dependence similar to that found at 25°C. The isopiestic ratios of the 1-1 electrolytes were independent of temperature, while those of the 2-2 and 2-1 electrolytes showed a linear decrease with increasing temperature. Surface Chemistry of Thoria in Dilute Aqueous Electrolytic Solutions. Theoretical estimates of the electrical surface potential required for stability of a slurry at selected values of temperature, ionic concentration, ionic valence, particle size, and slurry concentration were made. A sample of ThO_2 suitable for adsorption measurements was prepared by acid digestion of ThO_2 prepared from thorium oxalate. Corrosion by Solutions. Corrosion of types 347 and cast CD_4MCu stainless steel was studied in a solution containing 0.04 m UO_2SO_4, 0.025 m $CuSO_4$, and 0.05 m H_2SO_4 at 250 and 300°C. At 250°C, critical velocities were ~10 fps for type 347 and less than 10 fps for type CD_4MCu; at 300°C, respective critical velocities were 45 to 50 fps and ~30 fps. Pretreatment of type 347 in water was investigated. A titanium pump loop for use at temperatures and pressures up to 370°C and 3000 psia was constructed and tested with a simulated reactor fuel solution (UO_2SO_4, $CuSO_4$, $NiSO_4$, and D_2SO_4 in D_2O) at temperatures up to 365°C. At temperatures above the two-liquid-phase temperature, the salt concentration decreased and the acid concentration increased in the light phase. Corrosion of Ti and Zircaloy-2 specimens was found to be small. Corrosion tests with Al_2O_3 and Al_2O_3 brazed to Ti in water at 100 and 300°C and in simulated reactor fuel solution showed both materials to have good corrosion resistance in water, while only the brazed specimen had adequate resistance in the fuel solution. In the brazed specimen, the Al_2O_3 did not become detached from Ti. Corrosion tests of Al alloys in water for ten-day periods at temperatures from 170 to 290°C and at water flow rates of the total flow, coupled with the use of graphite of low permeability, would effectively remove the xenon poisoning problem. Thermodynamic Studies in Molten Salts. A method was developed for evaluating the association constants at infinite dilution for the association of Ag^+ and Cl^- in KNO_3. The activity coefficient of $AgNO_3$ in dilute solutions of $AgNO_3$ and NaCl in an equimolar mixture of $NaNO_3-KNO_3$ was measured at 233 to 528°C. Effects on the freezing point depression of NaF by added fluoride solutes were correlated to cation charge, polarization, and cation size. The heat of fusion of $3LiF \cdot ThF_4$, which melts in the range of 568 to 569°C, was determined to be 13,940 ± 50 cal/mole. The density vs composition curves of $LiF-BeF_2$, $NaF-BeF_2$, $LiF-BeF_2-UF_4$, and $NaF-BeF_2-UF_4$ were examined and found to give a linear relationship between molar volume and composition. Assuming the volume contribution of BeF_2 to be due to its fluoride ions, equations were developed for these systems and for $LiF-BeF_2-UF_4-ZrF_4-ThF_4$, with average deviations from observed results being less than 3%. INOR-8 Corrosion by Molten Fluorides. The self-diffusion coefficients of Cr in Inconel and INOR-8 alloys were measured at 675 to 875°C using Cr^{51}. Polythermal circulating INOR-8 loops under corrosive and noncorrosive conditions with molten fluorides gave results which were in good agreement with those predicted from measured diffusion coefficients. Fission Products in a Graphite–Molten Salt System. A specimen of S-4 graphite

exposed at 700°C for 1600 hr in the Materials Testing Reactor to $LiF-BeF_2-ThF_4-UF_4$ showed penetration by the salt to the extent predicted by out-of-pile studies. Gross fission product activity appeared on the salt only where the intrusion of fuel was observed in regions of high porosity. Except for these regions of intrusion, the graphite was free of fission product activity except for Cs^{134} and Cs^{137}. Aqueous Systems at Elevated Temperature. The simultaneous solubilities of $CuO \cdot 3UO_3$ and $3CuO \cdot SO_3 \cdot 2H_2O$ in solutions of H_2O and H_2SO_4 were measured at 325 and 350°C for total sulfate concentrations of 0.02 to 0.03 m. Solubilities of $3CuO \cdot SO_3 \cdot 2D_2O$ in $D_2O-D_2SO_4$ solutions were determined at 300, 325, and 350°C. The system $NiO-SO_3-H_2O$ was investigated at temperatures above 300°C; no liquid-liquid immiscibility exists in this system at saturation vapor pressure. Temperature-composition boundaries for liquid-liquid immiscibility and critical phenomena were determined for the system $UO_3-CuO-SO_3-D_2O$ (molal ratio of UO_2^{2+} to $Cu^{2+} = 1$), $UO_3-SO_3-D_2O$, and $CuO-SO_3-D_2O$. Temperatures for liquid-liquid immiscibility were determined for several aqueous reactor fuel solutions, and a method for estimating the minimum two-liquid-phase temperatures was developed which uses only the acidity molal ratio (D_2SO_4/total sulfate). The pH of dilutions of compositions containing UO_2SO_4, $CuSO_4$, and $NiSO_4$ was measured; a method is described for determining free D_2SO_4 in homogeneous reactor compositions. Three-dimensional solubility models for the system $UO_3-CuO-NiO-SO_3-D_2O$ at 300°C were constructed for total sulfate concentrations of 0.06, 0.10, 0.20, 0.30, and 0.50 m. Solubility information for the system $UO_3-N_2O_5-H_2O$ at 25 to 350°C is presented. The solution-solid equilibrium boundaries of the system $ThO_2-N_2O_5-H_2O$ were determined at 200 and 300°C. Reactions in Aqueous Solutions. The measured rates of peroxide decomposition in $UO_2(NO_3)_2$ solutions in presence of mixed iron and copper salts were found to be similar to these obtained with sulfate and perchlorate systems. It appears that the rate of peroxide decomposition in $UO_2(NO_3)_2$ solutions at high temperatures would be adequate for use in reactors. The relative dissolution rates of various solids in synthetic HRE-2 fuel solution were measured at 250°C. The solids tested were UO_2, U_3O_8, UO_3, $CuO \cdot 3UO_3$, and reactor fuel solids prepared by evaporating fuel solution to dryness and calcining at 500°C. The solids between 20 and 107 fps were conducted. The influence of water temperature, pH, and velocity on corrosion and on corrosion-product formation on Al alloys subjected to high heat fluxes was determined, and it is concluded that Al would be a suitable cladding material for fuel elements to be used in the High Flux Isotope Reactor. Corrosion by Solutions under Irradiation. The data on in-pile corrosion of Zircaloy-2 in UO_2SO_4 solutions were reviewed and correlated, and a model for this corrosion was developed. A large variety of zirconium alloy specimens were exposed in an in-pile experiment at 280°C to D_2O solutions of UO_2SO_4, H_2SO_4, and $CuSO_4$, and the results are described. The electrochemical measurements of Zircaloy-2 corrosion rates in oxygenated H_2SO_4 solutions were extended to 258°C, and results were obtained which support logarithmic oxidation kinetics of Zircaloy-2. Sorption of U from aqueous UO_2SO_4 solutions on Zr oxides was investigated. A D_2O solution of $UO_2(NO_3)_2$, $Cu(NO_3)_2$, and DNO_3 was irradiated in Zircaloy-2, and chemical yields and corrosion rates are estimated. It is concluded that $UO_2(NO_3)_2$ solutions are not particularly promising as reactor fuel solutions. Slurry Corrosion and Blanket Materials Tests. Test procedures, including exposure in static and rocking autoclaves, ball mills, spouted beds, and fluidized beds, are described and some of their results with thoria pellets prepared in several ways are described. Corrosion of Zircaloy-2 and other alloys was studied in in-pile autoclave tests with thoria–urania slurries; no effect of radiation on corrosion was observed. Hydriding of zirconium-base alloys is shown to occur on exposure to thoria-urania flurries under conditions of slug flow in toroids. Hydride formation does not occur at 200°C but is important at ≥280°C. Little effect of atmosphere or irradiation on hydrogen pickup of Zircaloy-2 was noted. The results of an in-pile loop assembly test with thoria–urania slurry at 280°C indicate a substantial degradation of the slurry. Transport of Noble Gases in Graphites. The mutual-diffusion coefficient for Ar and He in porous graphite was measured at 25 and 100°C and pressures of 1 to 6 atm. A model for diffusion in large-pore graphite was developed. Diffusion of Ar through porous septums and opposed to He flow was studied; Knudsen diffusion was observed at high pressure differentials. Interdiffusion of Ar and He in low-permeability graphite is shown to be similar to that in porous materials. Surface diffusion is shown to be negligible by experiments at 30, 0, and −65°C with Ar at 1.5 to 4 atm. Evolution of Gas from Graphite. The amounts and compositions of gases and their rates of evolution from moderator graphite materials were determined at temperatures up to 2000°C. A rough correlation of gas content and composition with ash content of the graphite is observed, and most evolution rates fit the equation $V = A \log t + B$, where V is the gas volume per 100 cm^3 of graphite, t is time, and A and B are constants. Some graphites, whose ash is high in CaO, evolve considerable CO_2 at 600°C. Measurement of Temperature in Reactor Environments. Selective oxidation of Chromel-P wires is responsible for large negative errors in emf of Chromel-P-Alumel thermocouples in mildly oxidizing environments. Abnormal emf readings were obtained when Chromel-P-Alumel couples sheathed in stainless steel were exposed at high temperatures to He contaminated with gases desorbed from graphites. Preliminary studies were made on oxidation of Chromel-P in H_2O-H_2 mixtures. Radioinduced composition changes in six thermocouple pairs were calculated for a thermal neutron flux of 10^{14} nv and for periods up to 20 yr; the results indicate that Chromel-Alumel should be the most stable thermocouple, with iron-Constantan the next most satisfactory combination. Removal of Radioactive Gaseous Fission Products from Other Gases. Studies were made of removal of iodine vapor from air–steam mixtures at 75 to 118°C, from air at 100°C, and from He at high temperatures. Dynamic adsorption measurements were made for Kr in He up to 420 psig, and effective diffusion coefficients for Kr were measured at 0 to 60°C. Retention of noble gases by Linde molecular sieves 4A and 5A was studied. Effect of Radiation on Beryllium Oxide. Cylindrical specimens of BeO were irradiated to fast-neutron dosages of 10^{21} nvt, and the resulting changes are described. Specimens receiving 7×10^{20} nvt exhibited cracks, and at heavier dosages, severe deterioration occurred. The type 430 stainless steel cladding increased in dimension up to 3%. Thermal conductivity decreases with increasing dosage. Preparation of Refractory Oxides from Molten Salts. Reaction with water vapor in the space above molten salt mixtures was used to precipitate single crystals of BeO and UO_2 from solutions of their fluorides. UO_2 prepared in this way shows a unit-cell parameter a_0 of 5.472 ± 0.002 A and corresponds to $UO_{2.00 \pm 0.003}$. Precipitation from solutions containing both BeF_2 and UF_4 produces some UO_2 which is completely encased in BeO. Preparation of Pure Beryllium Compounds by Solvent Extraction.

The effect of pH on the distribution coefficients for Be and several impurities was studied for a liquid–liquid extraction process for preparation of ultrapure $Be(OH)_2$. Results of spectrographic analysis of $Be(OH)_2$ prepared with this process are given. (D.L.C.)

19212 (RAD-TR-9-60-32) COMBUSTION OF CARBON IN AN AIR STREAM. Jeffrey A. Moore and Martin Zlotnick (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Dec. 14, 1960. Contract AF04(647)-305. 45p.

An investigation was made to determine the combustion rate of C operating at a surface temperature between 1000 and 3000°K in a stream of air. Relatively general forms of the surface reaction rate equations were used in the analysis, with the boundary layer equations simplified by letting Le = Pr = 1, so that the effect of the chemical kinetics could be elucidated. The results of the analysis can be used to make rapid engineering estimates of mass loss rate for a wide range of flight conditions. The accuracy of these estimates is limited primarily by the accuracy of the reaction rate parameters used rather than by the approximations used in the boundary layer equations, except when the combustion rate is controlled solely by diffusion and convection. Specific calculations, involving the graphical solution of two algebraic equations, were made at various stations on a blunted slender body for a flight Mach number of 15 and an altitude of 100,000 feet: The ablation rate for porous carbon approached the diffusion controlled value at the stagnation point for nose radii greater than 1 centimeter, but was found to be between the two limiting cases of reaction rate controlled and diffusion controlled at a distance of 400 centimeters downstream of the stagnation point. The ablation rate for non-porous carbon, however, was reaction rate controlled for every station and geometry considered. (auth)

19213 (SRB-61-2(Vol.I)) PROPERTIES OF CADMIUM SULFIDE, ZINC SULFIDE AND MERCURIC SULFIDE. PARTS I-III. An Annotated Bibliography. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Mar. 1961. 169p.

An annotated bibliography is presented on the crystal growth, crystalline, electrical, and optical properties of cadmium sulfide, mercuric sulfide, and zinc sulfide. (N.W.R.)

19214 (TID-7597(p.173-90)) THE REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE IN ELECTRIC DISCHARGES. H. C. Cowen (United Kingdom Atomic Energy Authority. Development and Engineering Group, Culcheth, Lancs, England) and R. Lind (United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England).

Experiments were conducted in which the reaction between graphite and electrically activated CO_2 was studied. In the first of these, the gas was maintained at a low pressure and activated by means of an electrodeless discharge induced from a high-frequency generator. The second study was carried out at atmospheric pressure using a battery of ozonizers in an attempt to understand the mechanism by which CO additions to CO_2 led to reduced weight loss. In the case of the high frequency discharge, phosphating proved to be ineffective in reducing the reactivity of graphite to both pile- and electrically-activated CO_2. In the ozonizer work it was clear that for the conditions used the attack on graphite was due to a long-lived species. Prolonged activation of pure CO under these conditions produced no detectable quantities either of carbon on the ozonizer surfaces or of CO_2 in the effluent gas. (M.C.G.)

19215 (TID-7597(p.207-28)) THERMAL AND MICROWAVE OXIDATION OF VARIOUS REACTOR-GRADE GRAPHITES. T. J. Clark (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Studies are being carried out on reactor-grade graphites to determine the effects on oxidation rates of such variables as purity, structure, coke type, and graphitization temperatures. Initial studies were in single-pass gas flow systems of three types: thermal, gamma-field, and microwave glow discharge. Preliminary data are given for the CO_2–graphite reaction. Results showed the advantages of gas purification over thermal purification in reducing oxidation rates. Pitch-impregnated samples showed selective oxidation in certain regions of their surfaces. Comparison of oxidation rates showed little change with change in coke types. Impregnated graphite with a density of 1.627 gm/cm^3 oxidized at a slower average rate than unimpregnated graphite with a density of 1.521 gm/cm^3. Varying the gas flow rate from less than 0.5 ft^3/hr to greater than 1.5 ft^3/hr had no noticeable effect on the oxidation rate. Reaction rates were found to be enhanced as a result of glow discharge. (M.C.G.)

19216 (TID-7597(p.253-66)) OXIDATION OF REACTOR GRAPHITE AT 400°C. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.).

Studies were made of the oxidation of reactor graphite at 400°C. The position in the original block from which the samples were taken was found to cause the greatest variation in oxidation rates. Cylinders machined from the outside of the block gave oxidation rates of about 0.10% per day while samples further from the surface oxidized about 0.25% per day. The oxidation did not occur uniformly throughout the samples. Data indicated that the oxidation rate is first-order with respect to oxygen pressure from $\frac{1}{4}$ to 2 atm and zero-order from 2 to 5 atm. The smaller the diameter of the graphite cylinders, the higher the oxidation rate became. The effects of cleaning samples ultrasonically in alcohol were also studied. (M.C.G.)

19217 (TID-7597(p.267-90)) THERMAL REACTIONS OF GASEOUS IMPURITIES IN FLOWING ARGON LEADING TO CARBON TRANSPORT. J. E. Antill and K. A. Peakall (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The effects of impurities in argon on carbon mass transfer were investigated. A silica spring balance was used to determine rates of weight loss for samples of graphite at 900 and 1000°C in a flowing stream of argon containing known amounts of O_2, CO_2, CO, H_2, and H_2O vapor. The weight loss versus time graphs were linear for a given set of experimental conditions. The reactivity of the impurities decreased in the order O_2, H_2O vapor, CO_2, and the rates increased with temperature and the partial pressure of the oxidizing gas, while H_2 and CO inhibited the attack. The carbon deposition reaction from CO was also studied. The amount of carbon deposited was calculated from the amount of CO_2 formed. (M.C.G.)

19218 (TID-7597(p.359-73)) THE RATE OF OXIDATION OF LARGE BLOCKS OF GRAPHITE IN AIR. H. C. Cowen, J. B. Lewis, and E. W. Sharratt (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Graphite oxidation was studied as a function of specimen size. In results initially obtained there seemed to be no correlation between oxidation rate and size of specimen. This was evidently due to the variability in the inherent reactivity of material machined from different blocks or

different positions within blocks, since when the size effect was studied by starting with a single 4-in. cube, oxidizing, machining to a smaller size, re-oxidizing, etc. rather than by machining the smaller specimens independently, such a correlation was observed. The errors inherent in estimating rates of heat production in graphite reactor blocks under fault conditions from oxidation data obtained from laboratory oxidation experiments were considered. Calorimetric measurements were carried out on oxidizing graphite samples to determine the rates of oxidation, heat release, and CO_2 production. No significant differences were found between irradiated and unirradiated material. (M.C.G.)

19219 (TID-7597(p.410-13)) G.E.C. LABORATORY WORK ON THERMAL REACTIONS. H. W. Davidson (General Electric Co., Ltd., Erith, Kent, England).

Progress in studies of out-of-pile gas-graphite corrosion reactions is reported. A threshold temperature for the gasification of amorphous carbon in CO_2 which differed from the corresponding temperature for graphite was not observed. It was also impossible to distinguish between powder and massive specimens. In an attempt to determine the total number of oxidizable sites on graphite, the surface oxide was stripped off with CO, then the graphite was covered with CO_2, and the amount of CO produced was measured. Data from other studies suggested that the less-well graphitized carbons and the neutron-irradiated graphites give a substrate which encourages carbon deposition to a greater extent than the structurally more perfect materials. It was found that CO_2 has exceptional ability to penetrate graphite. (M.C.G.)

19220 (TID-7597(p.414-51)) THE EFFECTS OF DIFFUSIONAL CONTROL OF OXIDATION OF GRAPHITE. P. J. Robinson (United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England).

Methods used for estimating the extent of diffusional control of graphite oxidation and for applying these results to the determination of highest safe moderator temperatures are discussed. The parameters used, general solutions of the problem, particular solutions, and a theory of thermal instability are given. The magnitude of the restriction of the oxidation rate by resistance to diffusion of gas through the pores determined by this treatment agreed well with more rigorous treatments and with experimental results. (M.C.G.)

19221 (TID-7597(p.453-70)) THE PREDICTION OF CONDITIONS FOR SELF-SUSTAINING GRAPHITE COMBUSTION IN AIR. J. S. Nairn and V. J. Wilkinson (United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England).

For air-cooled reactors, the exothermic reaction between graphite and oxygen imposes a limit on the maximum temperature permissible if combustion hazards are to be avoided. A general treatment was derived to form the basis for predicting the conditions under which self-sustaining graphite oxidation could arise. The relative rate of heat generation and heat loss in air and air–CO_2 mixtures was determined. The effects of impurities and radiation on the oxidation rates were investigated. (M.C.G.)

19222 (TID-7597(p.471-503)) THERMAL INSTABILITY DUE TO OXIDATION OF A GRAPHITE CHANNEL CARRYING AN AIR FLOW. P. J. Robinson and J. C. Taylor (United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England).

A theoretical approach was developed which predicts the limitation in permissible temperatures imposed by graphite oxidation effects in an air-cooled graphite-moderated reactor. The model used in the theory was that of a regular graphite lattice penetrated by parallel channels carrying a coolant air flow. Experimental confirmation that runaway conditions could be obtained at temperatures predicted by the theory and that the equilibrium temperature distribution along the channel was correctly predicted was obtained. (M.C.G.)

19223 (TID-7597(p.504-22)) THE DEGASSING OF GRAPHITE. R. C. Asher (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The degassing of graphite which occurred on raising the temperature suddenly from T_1 to T_2 was studied. The desorbate was pumped continuously into the collecting volume where its volume was estimated and its composition determined. It was found that desorption continued for at least 3 days and became asymptotic to a value V, the total gas content from T_1 to T_2. There was a variation of V between nominally identical specimens. The composition of the desorbate depended on the experimental conditions. The major constituents above 1000°C were carbon monoxide and hydrogen in roughly equal proportions. At lower temperatures, hydrogen was progressively replaced by methane, and carbon monoxide by carbon dioxide and water vapor. Readsorption from the atmosphere on degassed samples was also measured. It was found that the weight increase in air depended on the previous degassing treatment. (M.C.G.)

19224 (TID-7597(p.545-59)) NITROGEN-GRAPHITE COMPATIBILITY STUDY. Robert H. Fox (California. Univ., Livermore. Lawrence Radiation Lab.).

Theoretical and experimental investigations were made of nitrogen-graphite compatibility. Thermodynamic calculations were made of partial pressures and maximum corrosion rates. Nitrogen was blown through an electrically heated graphite tube. Measurements were made of gas and outside wall temperature, pressure, flow rate, electric power, corrosion rate, and oxygen and water vapor content. Corrosion profiles were obtained by measuring the pre- and post-run x-ray photographs of the tubes. Results indicated that reaction kinetics controlled the reaction rate. (M.C.G.)

19225 (TID-7597(p.586-96)) THE INHIBITION OF GRAPHITE OXIDATION BY HYDROGEN. Robert F. Stewart and William T. Abel (Bureau of Mines, Washington, D. C.).

The rates of reaction of graphite with steam, carbon dioxide, and hydrogen impurities in helium were determined. The effect of hydrogen in retarding the oxidation of graphite was studied. It was found that a small amount of hydrogen strongly retards the reaction of graphite with steam and a tenfold excess of hydrogen-to-steam reduced the oxidation rate to about $1/10$ the rate in a corresponding steam–helium atmosphere. This hydrogen-graphite reaction can be used to inhibit the reactions of trace oxidizing impurities in a helium system. (M.C.G.)

19226 (TID-7597(p.698-732)) REACTIONS OF REACTOR MATERIALS WITH CONTAMINANTS OUTGASSED FROM GRAPHITE. J. H. DeVan, ed. (Oak Ridge National Lab., Tenn.).

The nature of reactions between reactor materials and contaminants outgassed by graphite was found to depend strongly on the surface area of the metal relative to the volumes of coolant gas and graphite and on the temperature

structure of both the graphite and metal components. In experiments in which graphite and metal geometries were made to simulate those of the Experimental Gas Cooled Reactor, contrasting results were observed at 1400 and 1100°F. At the higher temperature, reaction of outgassed contaminants with structural metals was extremely fast, so that gas mixtures tended to approach equilibriums in favor of the metals rather than the graphite. Gas-metal reactions resulted in effective cleanup of the coolant within the first 100 hr of operation at 1400°F. At 1100°F, gas impurities approached concentrations which tended to be in equilibrium with graphite. Experiments supported the conclusion that gas mixtures produced through the outgassing of the graphite and inleakage of air into helium will affect the oxidation of type 304 stainless steel. Transition oxide films at the oxide-metal interface showed x-ray patterns characteristic of $MnO \cdot (Cr, Fe)_2O_3$. Helium mixtures containing small amounts of CO were found to oxidize as well as carburize type 304 stainless steel at 1500°F. Very low partial pressures of CO_2 affected oxidation of type 304 stainless steel at rates which were insensitive to changes in the CO_2 pressure. The presence of an oxide film on the stainless steel did not markedly retard the rate of carburization. (auth)

19227 (TID-7597(p.831-58)) GRAPHITE-METAL COMPATIBILITY AT ELEVATED TEMPERATURES. J. C. Bokros (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Various metals and alloys were evaluated for their compatibility with graphite in helium at elevated temperatures. All of the alloys which contained appreciable amounts of Al as an alloying element and the Ni-base alloys which contained Cr were internally oxidized by an impurity in helium. Niobium and its alloys showed a tendency to be oxidized at low temperatures and carburized at high temperatures. The rate of carbide penetration of molybdenum was too high for it to be considered as a thin-walled graphite cladding for long periods of time at 927°C. The ferritic stainless steels showed resistance to carburization up to 816°C. Preliminary testing of the mechanical properties of carburized nickel and Monel indicated that the room temperature ductility does not suffer from carburization or graphitization and that copper as an alloying addition to nickel reduces the graphitization rate markedly. Austenitic stainless steels showed low carburization resistance. All of the coatings evaluated proved to be inadequate at 927°C. (M.C.G.)

19228 (TID-12643) PROGRESS REPORT, 1960-1961. I. THE THERMODYNAMICS AND KINETICS OF COORDINATION COMPOUNDS. II. THE CHEMISTRY OF URANIUM SALTS IN SOLUTION. Michael Cefola and Philip S. Gentile (Fordham Univ., New York). Apr. 21, 1961. Contract AT(30-1)-906. 65p.

Programmed tapes were prepared for a computer for handling least squares, kinetic data for first- and second-order reactions and titration, and polarographic and spectrophotometric data for calculating stability constants. Vapor pressure studies of metal-urea complexes using an effusion technique were undertaken and data are presently being interpreted. Nickel-urea complexes of high purity were prepared in nickel-urea mole ratios of 1:1, 1:2, 1:3, 1:4, 1:5, and 1:6 by solid-solid interactions. This technique appeared to yield metastable nickel complexes never prepared before, in addition to the normal complexes. The ratio of hydrolysis of thiolacetic acid and the activation energy of the reaction was obtained. A polarographic technique was used to obtain stability constants and thermodynamic data between Pb^{2+}, Sn^{2+}, and Ni^{2+} and thiolacetic acid. The kinetics of the reactions of Ni^{2+} with diketones were determined. Stability constants were found for the reactions of Cu and acetylacetone and also acetylacetone alone in mixed solvents. Results of other studies indicated that the optical densities of gas mixtures may in certain cases be related to the dielectric properties of the mixtures. It was also concluded that the Lorentz theory of pressure broadening may not be applicable to mixtures of gases at low pressures when a considerable difference exists between the dielectric of the gases. An attempt was made to determine whether hydrogen uranates, diuranates, or polyuranates are obtained upon addition of base to uranyl nitrate solutions. (M.C.G.)

19229 (TID-12761) THERMODYNAMICS AND CONDUCTANCE OF SIMPLE ELECTROLYTES IN POLAR ORGANIC SOLVENTS. Progress Report No. 5. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1960. Contract AT(30-1)-1999. 7p.

The program was concerned with the properties of inorganic electrolytes dissolved in anhydrous actonitrile. Information relating to ionic interactions and solute-solvent interactions was of particular interest. Potassium iodide was used to study the dilute concentration region and silver nitrate for the high concentration region. Cobaltous halide salts were used to study systems which exhibit pronounced complex-ion behavior. Data on ionic mobilities for $AgNO_3$ and KI in CH_3CN and water are tabulated. An expression for the interactions of cobaltous halides is given. (J.R.D.)

19230 (TID-12800) CARBON-13 KINETIC ISOTOPE EFFECTS IN THE UREASE-CATALYZED HYDROLYSIS OF UREA. I. TEMPERATURE DEPENDENCE. K. R. Lynn and Peter E. Yankwich (Illinois. Univ., Urbana. Noyes Lab. of Chemistry). 1960? 48p.

The C^{13} kinetic isotope effects in the urease-catalyzed hydrolysis of urea were measured with several preparations of the enzyme in two buffers (maleic acid-maleate, and tris-hydroxymethyl amino methane-sulfuric acid) in which the kinetics were studied previously. The results indicate that the mechanism of the hydrolysis possesses complexities not reflected in the gross rate phenomena which do influence the isotope fractionation. The isotopic analogues of the several mechanisms found adequate to explain the kinetics of the reaction are examined in detail. It was concluded that complexity at the molecular level, probably involving temperature-dependent interconversion of two or more types of active sites (directly, or indirectly through enzyme conformational changes), is responsible for the isotope effect results obtained. (auth)

19231 (AEC-tr-4062) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, Volume II, No. 12, 1957. 266p. (PST-Cat.-89).

A cover-to-cover translation of this journal containing 24 papers is presented. Separate abstracts were prepared for 6 papers. (M.C.G.)

19232 (AEC-tr-4062(p.1-8)) CHEMICAL PROPERTIES OF CERIUM HYDRIDES. M. E. Kost. Translated from Zhur. Neorg. Khim., 2: No. 12, 2689-93(1957).

The chemical properties of cerium hydrides were investigated. A direct hydrogenation of metallic cerium was used in the preparation of the cerium hydrides. Exposure of cerium hydride to CO_2 even for a short time resulted in some passivation. Prolonged storage of cerium hydride samples in an atmosphere of CO_2 did not change their composition. The bromination of cerium hydride was carried out by passing HBr over cerium hydride and heating.

The yield of $CeBr_3$ is about 80%. The reaction of the trihydride with water took place according to the equation: $CeH_3 + 3H_2O \rightarrow Ce(OH)_3 + 3H_2$. In the case of the dihydride, the following reaction took place: $CeH_2 + 3H_2O \rightarrow Ce(OH)_3 + 2.5H_2$. The hydrolysis of the dihydride was much slower than that of the trihydride. (M.C.G.)

19233 (AEC-tr-4062(p.9-18)) INTER-TRANSITION OF VARIETIES OF MANGANESE DIOXIDE. Yu. D. Kondrashev. Translated from Zhur. Neorg. Khim., 2: No. 12, 2694-9 (1957).

The modifications known to exist in the crystal structure of MnO_2 are described. The possibility of transformation of the MnO_2 varieties was investigated. It was established that aging of polyamorphous MnO_2 can cause the formation of three modifications: α-, β-, and γ-MnO_2. All three regulated modifications α-, β-, and γ-MnO_2 were obtained from dispersed ϵ-MnO_2 by changing the conditions of thermal treatment. By heating in H_2SO_4 at 140°, α-MnO_2 was transformed into β-MnO_2. Transition of γ-MnO_2 into β-MnO_2 occurred above 160° in HNO_3. (M.C.G.)

19234 (AEC-tr-4062(p.19-33)) STUDY OF THE REACTION OF FORMATION OF NICKEL HYDROXIDE IN AQUEOUS SOLUTIONS. L. V. Tananaev and M. Ya. Bokmel'der. Translated from Zhur. Neorg. Khim., 2: No. 12, 2700-8(1957).

The precipitation of nickel hydroxide by sodium hydroxide from dilute solutions of nickel sulfate and nitrate was studied. The research was carried out by methods of physicochemical analysis: solubility, pH measurement, electroconductivity, and apparent volume of the precipitate. Results indicated that in the reaction of nickel sulfate with sodium hydroxide, even in dilute solutions, the formation of basic salts is unavoidable. The conclusion of Besson and Berger that the predominant composition of the basic salt is $NiSO_4 \cdot 4Ni(OH)_2$ was confirmed. This compound was not stable, was easily hydrolyzed in water, and reacted with alkali forming a series of salts of intermediate composition. The composition of these salts depended on the concentration of the initial solution and the conditions of the reaction. In the interaction between a 0.01M nickel nitrate solution and sodium hydroxide, the basic salt $Ni(NO_3)_2 \cdot 19Ni(OH)_2$ precipitated, but on mixing for one hour with the mother liquor at 25°, this salt was completely hydrolyzed, leaving pure nickel hydroxide. (M.C.G.)

19235 (AEC-tr-4062(p.97-107)) INVESTIGATION OF THE EXTRACTION OF RUTHENIUM WITH ORGANIC SOLVENTS FROM NITRATE SOLUTIONS. V. D. Nikol'skii and V. S. Shmidt. Translated from Zhur. Neorg. Khim., 2: No. 12, 2746-51(1957).

The extraction of ruthenium tetroxide, tetravalent ruthenium nitrate, and ruthenium nitrosonitrates from nitrate solutions with diethyl ether, solutions of tributyl phosphate in aqueous paraffin, and with aqueous paraffin was studied. The experiments, designed for the quantitative determination of distribution coefficients, were conducted with compounds of labeled Ru^{106}. Results showed that tetravalent ruthenium nitrate is not extractable by the solvents used. Experiments with RuO_4 showed that this compound is quickly reduced to nonextractable compounds. Ruthenium was extracted to a considerable extent from ruthenium nitrosonitrates by all the solvents. The distribution coefficient increased when the acidity was raised. Compounds extractable with ether, when standing in solutions of low acidity were gradually transformed into non-extractable compounds. In general salting-out agents caused an increase in extraction of ruthenium from nitrate solutions. (M.C.G.)

19236 (AEC-tr-4062(p.120-6)) PHYSICAL PROPERTIES OF RUTHENIUM (THE PROBLEMS OF POLYMORPHISM OF RUTHENIUM). A. A. Rudnitskii and R. S. Polyakova.. Translated from Zhur. Neorg. Khim., 2: No. 12, 2758-61(1957).

The physical properties of ruthenium were studied on a specimen having 0.2% impurities. A monolithic metal specimen was prepared by metallic-ceramic methods. The specific gravity, microstructure, and lattice structure were determined. The Binell hardness and specific electrical resistance of annealed and tempered specimens was measured. The temperature coefficient of electrical resistance was established. To determine the possibility of polymorphism, differential thermal analysis was performed. The thermoelectric properties were studied. Results from room temperature to 1250° indicated that absence of polymorphous transformations in this temperature interval. (M.C.G.)

19237 (CEA-tr-X-249) IRRADIATION DU NICOTINATE D'AMMONIUM PAR DES NEUTRONS LENTS. (Irradiation of Ammonium Nicotinate with Slow Neutrons). U. Belluco, R. Barbieri, and G. Schiavon. Translated into French by L. Roulet from Gazz. chim. ital., 88: No. 1, 78-88(1958). 27p.

By irradiation of ammonium nicotinate with slow neutrons, radioactive substances uniformly labeled with C^{14} are obtained. Different methods used for identification and isolation of these substances gave comparable results. Several C^{14}-labeled substances were isolated and identified. In this manner it is possible to prepare several organic acids uniformly labeled on all C atoms with a high specific activity and a high yield. (tr-auth)

19238 THE HELLMANN-FEYNMAN THEOREM AND CHEMICAL BINDING. Richard F. W. Bader and Glenys A. Jones (Univ. of Ottawa). Can. J. Chem., 39: 1253-65(June 1961).

The advantages of the electrostatic interpretation of chemical binding are illustrated. The forces exerted by the electrons in a molecular orbital may be determined by general expressions. These are functions of only one parameter, the value of which is easily specified for a particular case. From the general expressions it is possible to obtain quantitative measures of the bonding or antibonding power of a molecular orbital. The usual interpretations of bonding and antibonding properties in molecular orbital theory are misleading and few orbitals are, in actual fact, antibonding. If molecular orbitals are classified as net bonding or net antibonding, terms which are precisely defined and have a definite physical significance, a much closer correlation with previous concepts of bonding is obtained. The effects of mutual orthogonalization within a set of orbitals are studied. This procedure decreases the bonding ability of bonding orbitals, but increases that of antibonding orbitals. The dangers of disregarding such orthogonalization in a conventional calculation are clearly illustrated. (auth)

19239 THE EMISSION OF THE RADICAL ND IN THE ATOMIC FLAMES OF SOME COMPOUNDS PREVIOUSLY MIXED WITH D_2O. Guy Pannetier, Henri Guenebaut, Louis Marsigny, and Pascal Deschamps (Laboratoire de Chimie Generale du Centre d'Orsay de la Faculte des Sciences, Paris). Compt. rend., 252: 1959-61(Mar. 27, 1961). (In French)

Flames maintained by atomic oxygen or nitrogen were realized beginning with mixtures of D_2O with different aliphatic amines, acetonitrile, or dimethylhydrazine. A single emission containing deuterium is observed: that of ND.

The existence of isotopic exchanges in agreement with the Brodsky theory is shown. Different origins are attributed to the formation processes of the radical ND. (tr-auth)

19240 A SPECTROPHOTOMETRIC STUDY OF ZIRCONIUM CHLORIDE SOLUTIONS IN CONNECTION WITH THE ABSORPTION OF ZIRCONIUM ON THE FLUORINE POLYMER FLUOROPLAST-4(F-4). I. E. Starik, I. A. Shul'skii, and V. N. Shchebetkovskii (Khlopin Radium Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 356-8(Mar. 11, 1961). (In Russian)

The distribution coefficient of Zr^{95} on the fluorocarbon F-4 decreases with increasing HCl concentration due to the formation of chloride complexes. Zirconium was found to have only a slight spectrophotometric absorption in 2N perchloric acid, while the absorption was very significant in the region of 213 to 250 mμ for zirconium in 1N, 2N, 6N, 8N and 9N HCl. The degree of complexing of zirconium by chloride ions could be estimated from the optical density of zirconium chloride solutions at 213 to 250 mμ. At equal concentrations of chloride ions in NaCl, KCl and NH_4Cl solutions, the amount of Zr^{95} adsorbed by the fluorocarbon F-4 is higher than the amount of Zr^{95} adsorbed in HCl and LiCl solutions. The spectrophotometric data also show that the degree of complexing of zirconium decreases in the following series: $H^+ > Li^+ > Na^+ > K^+ > NH_4^+$. (TTT)

19241 THE MECHANISM OF IODINE TRANSFER FROM VARIOUS SOLVENTS TO CHARCOAL WITH INTERNAL DIFFUSION ON THE IODINE ABSORPTION. A. N. Kharin and N. A. Kataeva (Taganrog Radiotechnical Inst., [USSR]). Doklady Akad. Nauk S.S.S.R., 137: 359-62(Mar. 11, 1961). (In Russian)

The absorption of iodine from water, ethyl alcohol, benzene and carbon tetrachloride was followed as a function of time on three different charcoals of varying porosity. The sample of charcoal (0.1 g in H_2O and 0.4 g in the other media) was agitated with 1.5 liters of iodine solution (1 mg-eq of iodine per liter). The liquid in contact with the charcoal was replaced at definite intervals with fresh iodine solution in order to maintain the initial concentration of iodine. It was found that the heat of wetting of the charcoal with water was less than it was with the non-aqueous media (by about a factor of two). The equilibrium amount of iodine absorbed a_0 (in mg-eq per g) was inversely proportional to the heat of wetting of the charcoal. The value of a_0 decreases in the order $H_2O > CCl_4 > C_6H_6 > C_2H_5OH$ due to a decrease in absorption with increasing solubility of iodine in the solvent. An analysis of the kinetic data shows that the rate of absorption of iodine from water is controlled by diffusion through the pore walls, and hence, depends only slightly on the type and porosity of the charcoal employed. On the other hand, the rate of absorption of iodine from benzene, alcohol and chloroform is controlled by diffusion in the body of the pore, and can vary widely with the porosity and absorptive ability of the charcoal. (TTT)

19242 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR DISPENSING LIQUIDS. James Roland Sanderson and Tony Mason (to United Kingdom Atomic Energy Authority). British Patent 868,136. May 17, 1961.

A dispensing apparatus for feeding small volumes of liquids into a system in a steady flow is described. The dispenser consists of a chamber, an outlet port, a movable closure member for the outlet port, means for oscillating the member to open and close the port, means for maintaining a constant liquid level in the chamber, and a tube connecting the outlet port. The tube is of a length and internal diameter such that capillary attraction is exerted on liquid flowing into the tube whereby intermittent liquid flow is converted to continuous flow. (N.W.R.)

Analytical Procedures

19243 (AERE-AM-77) THE POLAROGRAPHIC DETERMINATION OF TIN IN STAINLESS STEEL. K. R. J. Cottell (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England). Mar. 1961. 6p.

A polarographic method is given for determining amounts of Sn as low as 10 μg in stainless steel. In this method, the steel is dissolved in H_2SO_4 and the Sn separated as the sulfide using Mo as carrier. The Mo is removed by coprecipitation of the Sn with Fe as hydroxides, and Sn is determined in $HCl-NH_4Cl$ solution with a cathode-ray polarograph. (D.L.C.)

19244 (AERE-AM-79) THE DETERMINATION OF TITANIUM IN ZIRCONIUM AND ZIRCONIUM TETRACHLORIDE. E. Bowell and P. T. S. Sandon (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England). Jan. 1961. 5p.

A method is given for determining Ti in Zr and $ZrCl_4$ in amounts ranging from 5 to 100 ppm. In this method, a concentrated H_2SO_4 solution of the sample is prepared, and Ti is determined absorptiometrically as the thymol complex. (D.L.C.)

19245 (CF-61-3-39) STUDIES OF SURFACE CONTAMINATION. I. INTERCOMPARISON OF METHODS FOR MEASURING "REMOVABLE" CONTAMINATION. George W. Koyster, Jr. and Birney R. Fish (Oak Ridge National Lab., Tenn.). Mar. 8, 1961. 11p.

A study was undertaken to evaluate the smear and adhesive paper techniques for measuring surface contamination, and to compare these with a new method of sample collection. This third sampling procedure employs air impingement to redisperse loose contamination from the surface and the resulting airborne material is collected on a filter. These air impingement samples are referred to as "smair" samples. A 490-liter plexiglas box was used as a dust settling chamber for ThO_2 dust and all three sampling methods were used. Preliminary studies indicated that smears taken over a large area show a lower apparent average level of removable contamination than smears taken over a small area. Samples taken with the adhesive paper and smair samples showed that the activity of these samples varies directly with the size of the area measured. (M.C.G.)

19246 (CNI-42) ANALISI CON SPETTROMETRIA DI MASSA DI CAMPIONI DI ACQUE LEGGERE A TENORE IN D_2O FINO ALL '1%. (Analysis by Mass Spectrometry of Samples of Light Waters Enriched with D_2O up to 1%). W. Barbieri, A. Chiesa, A. Colombo, and B. Versino (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). [196?]. 14p.

Samples of light waters enriched in D_2O were analyzed by mass spectrometry after reduction with U and Zn respectively at 600°C and 400°C. Calibration curves, apparatus used, and possible errors are given. (auth)

19247 (CNI-46) ANALISI ISOTOPICA DI ACQUA LEGGERA. (Isotopic Analysis of Light Water). S. Sandroni and W. Barbieri (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). [196?]. 12p.

A method of analysis of D_2O content in light water by infrared spectrometry is described, using the OD absorption

band at 4μ. Possible error factors, such as temperature and salt effect, were studied. Using some precautions, an accuracy of 20-ppm D_2O was obtained. The method is applied to determine leaks of heavy water in the secondary cooling circuit of Reactor Ispra I. (auth)

19248 (DP-573) A POLAROGRAPHIC TEST FOR SOLVENT QUALITY. Robert C. Propst (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1961. Contract AT(07-2)-1. 11p.

Irradiated tributyl phosphate–kerosene solvent from the Purex process exhibits polarographic waves that are indicative of the degree of degradation of the solvent. The polarographic test offers advantages of speed and better precision in comparison with the "Z" test for solvent quality. (auth)

19249 (GAT-T-924) SPECTRAL EXCITATION WITH STABILIZED PLASMA JETS. Louis E. Owen (Goodyear Atomic Corp., Portsmouth, Ohio). May 17, 1961. Contract AT(33-2)-1. 19p.

Stabilized plasma jets, used for gas sample or solution excitation, exhibit an unusual steadiness for what is basically a d-c arc. With one jet model, useful for isotopic assay systems, uranium spectra can be directly excited from gaseous UF_6. The more generally useful model is adapted to the spectral excitation of solutions. Stabilized plasma jets are characterized by high-temperature excitation, great optical brightness, large power input capability, and steady-state operation. (auth)

19250 (HW-27400) THE DETERMINATION OF FLUORIDE IN PLUTONIUM METAL BY THORIUM TITRATION. W. S. Ferguson and D. M. Newell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 4, 1954. Decl. Feb. 3, 1961. Contract W-31-109-eng-52. 17p.

A titrimetric method for the determination of fluoride in plutonium is reported. Prior to a steam distillation of the fluoride, the bulk of the plutonium is separated by precipitation of the sulfate. The fluoride in the distillate is titrated at a pH of 3.2 with 0.001M thorium nitrate using chrome azurol-S indicator. Applied to samples containing 1 to 15 parts per million fluoride, the recovery is 87%, and the precision on the 95% confidence level is ±0.65 ppm. (auth)

19251 (HW-67772) SPECTRAL ANALYSIS OF MICROWAVE ACTIVATED CARBON DIOXIDE. T. J. Clark and R. C. Giberson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1960. Contract AT(45-1)-1350. 21p.

Spectral analysis of a microwave glow discharge in CO_2 indicated the presence of CO_2 or CO_2^+, CO, CO^+, O, O^+, O_2, O_2^+, C, and C_3O_2. A microphotometer was used to study the effects of pressure and input power level on the concentration of these components in the glow. (auth)

19252 (KR-6) LIMITING FACTORS IN APPLICABILITY OF THE SEMI-QUANTITATIVE COPPER SPARK METHOD. M. S. El Alfy and J. Haaland (Norway. Institutt for Atomenergi, Kjeller). Mar. 1961. 13p.

The reproducibility of the copper spark method was improved markedly by using solutions 0.01 N in hydrochloric acid instead of the conventional 0.3 N (1%). Quenching effects from Na, Fe, and Al on intensity of common element lines were investigated in some detail. A steam heated evaporation device was found superior to infrared lamps or electrical devices. (auth)

19253 (NAA-SR-Memo-6010) U^{235} ENRICHMENT DETERMINATION BY GAMMA SPECTROMETRY. T. B. Crockett (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 5, 1961. 10p.

A study was conducted to determine the precision by which U^{235} could be determined by gamma spectrometry. The investigation utilized a 3 in. × 3 in. NaI (Tl) well crystal and photomultiplier tube and a RCL 256-channel analyzer. Uranium standards obtained from the National Bureau of Standards were used for the study. The intermediate enrichments were simulated by making use of the memory in the multichannel analyzer. Integrated photopeak intensities of the 0.184 Mev gamma ray peak were plotted versus percent enrichment. A straight line through these points was fitted by a least squares method. The individual points deviated <1% from the line. (auth)

19254 (NP-10163) ANALYTICAL CHEMISTRY MANUAL FOR ARMY NUCLEAR POWER PLANTS, SECONDARY WATER CONTROL. A. S. Powell, P. F. Santoro, and R. H. Gale (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). [1958?]. Contract DA-44-192-ENG-9. 191p.

Included are discussions of gravimetric, filter-photometric, spectrophotometric, volumetric, and instrumentation procedures prepared to serve as a practical operating guide on secondary-water control for process-control personnel assigned to SM-1. A review of important laboratory safety rules is presented. (B.O.G.)

19255 (PG-Report-171) THE ANALYTICAL CHEMISTRY OF BERYLLIUM. Proceedings of a Symposium, Blackpool, June 1960. J. Metcalfe and J. A. Ryan, eds. (United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England). Nov. 24, 1960. 180p.

Eleven papers are included on the determination of beryllium by various methods and the analysis of beryllium for impurities. Separate abstracts were prepared for the individual papers. (B.O.G.)

19256 (PG-Report-171(p.15-24)) THE ABSORPTIOMETRIC DETERMINATION OF BERYLLIUM. T. J. Hayes (United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England).

A discussion is given of the determination of beryllium in swab samples using acetylacetone, aluminum, Berillon, p-nitrobenzene-azo-orcinol, and solochrome cyanine. The sensitivities of absorbancy are given as: 0.0003, 0.0008, 0.0007, 0.003, and 0.0006 μg Be/cm^2, respectively. It is concluded that only acetylacetone and Berillon can be recommended for routine use of the reagents examined. (B.O.G.)

19257 (PG-Report-171(p.25-41)) METHODS OF BERYLLIUM DETERMINATION USED AT THE NATIONAL CHEMICAL LABORATORY. E. C. Hunt and J. V. Martin (Gt. Brit. National Chemical Lab., Teddington, Middx., England).

A discussion is given of the analytical requirements needed to determine beryllium in: high-grade ores containing 10 to 13% BeO; low-grade ores containing 0.001 to 0.1% BeO, and 0.2–5% BeO; residues and solutions from break-down and leaching tests on ores; smear and air-dust samples containing 0.2 to 10 μg beryllium; and soils containing beryllium in the ppm range. Methods for breaking down the beryl ores prior to analysis are described. The methods outlined for the determinations are: gravimetric, absorptiometric, geochemical, radiometric fluorimetric, and spectrographic. (B.O.G.)

19258 (PG-Report-171(p.43-54)) ALPHA AND GAMM IRRADIATION TECHNIQUES FOR BERYLLIUM DETERMI

NATION. H. Bisby and F. H. Hale (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A description is given of the development of a portable (γ,n) electronic equipment which was used to revolutionize the survey methods of the field geologist, and two types of laboratory equipment which can provide a rapid analytical service on almost all aspects of a complete beryllium program. (auth)

19259 (PG-Report-171(p.55-72)) THE DETERMINATION OF BERYLLIUM BY THE PHOTONEUTRON METHOD. G. W. C. Milner and J. W. Edwards (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The (γ,n) method for the determination of beryllium is described. Interferences are small with the exception of elements having high thermal-neutron cross sections. These include boron, cadmium, samarium, and gadolinium. This interference is easily avoided by surrounding the sample with a shield of cadmium to absorb thermal neutrons. Large concentrations of deuterium can cause a small positive error from the 0.2% of 2.3 Mev photons from Sb^{124}. Applications of the method include the determination of beryllia in selected minerals, including hand picked beryls and beryl pegmatites. Concentrate and tailing fractions produced in the mineral dressing treatments were analyzed for BeO content. Under the best conditions the lower limit of detection of the method is <0.002% BeO. (auth)

19260 (PG-Report-171(p.73-80)) THE DETERMINATION OF OXYGEN IN BERYLLIUM BY ACTIVATION ANALYSIS. R. F. Coleman (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England).

An outline is given of possible nuclear reactions applicable in the activation analysis of oxygen using fast and thermal neutrons, gamma rays, and charged particles. The determination using fast neutrons is described, specifically. A discussion is given of the calibration of a standard beryllium sample, and the errors caused by impurities in samples. The chief disadvantage of the activation method is that the samples must be a standard size and shape. Other elements in which oxygen may be determined by the (n,p) reaction are given. (B.O.G.)

19261 (PG-Report-171(p.81-92)) THE DETERMINATION OF OXYGEN IN BERYLLIUM BY VACUUM FUSION AND BY CHEMICAL METHODS. A. Parker (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England).

The selection of a method for oxygen analysis depends on the expected oxygen content and the amount and form of sample available. Both the vacuum fusion and the HCl methods are of general use provided that in the latter case the oxygen content is relatively high and that a sufficient quantity of sample is available. Methods based on selective solution techniques may be of value for certain specific purposes, e.g., process control. (auth)

19262 (PG-Report-171(p.93-117)) THE DETERMINATION OF IMPURITIES IN BERYLLIUM BY CHEMICAL OR NEUTRON ACTIVATION ANALYSIS. R. Todd (United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England).

The chemical methods in routine use at Springfields are assessed with regard to speed and precision. Neutron activation methods for determining sodium and uranium impurities are described. (auth)

19263 (PG-Report-171(p.119-37)) PHYSICAL METHODS FOR THE ANALYSIS OF BERYLLIUM. M. S. W. Webb and H. I. Shalgosky (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England).

Discussions are given of optical-emission spectroscopy and x-ray fluorescence spectroscopy techniques which may be used for rapid determinations of trace impurities on a routine scale. Of the optical techniques, the carrier distillation and total burn methods are considered the more versatile and less likely to suffer contamination from adventitious impurities. The x-ray technique is rapid, nondestructive, and requires little or no sample preparation, which makes it particularly attractive for the analysis of beryllium because of the safety precautions involved in handling. (B.O.G.)

19264 (PG-Report-171(p.139-53)) THE SPECTROCHEMICAL DETERMINATION OF BERYLLIUM IN AIR, SWABS, URINE, AND BIOLOGICAL TISSUE. A. E. Sawyer (United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England).

Studies indicate that spectrographic methods are in general to be preferred to either absorptiometric or fluorimetric procedures for determining small amounts of beryllium. Approaches to the determination of beryllium in air are: methods in which the beryllium is totally dissolved and the solution excited; and methods in which beryllium, either in an air stream or after collection on a filter, is excited directly in its particulate form. The quantities of beryllium for which swabs are usually examined are such that the sensitivity of solution methods is more than sufficient and some degree of dilution is normally required. When the analysis of either urine or biological tissue is undertaken, emphasis is no longer centered on speed of analysis but shifts to the more exacting concentration of very small quantities of beryllium from larger quantities of inorganic and organic matter. (B.O.G.)

19265 (PG-Report-171(p.155-75)) THE FLUORIMETRIC ESTIMATION OF MICROGRAM QUANTITIES OF BERYLLIUM IN LABORATORY AND WORKSHOP ATMOSPHERES. H. F. Molineaux, F. Trowell, and G. B. Turnbull (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England).

The procedure for the fluorimetric determination of beryllium by the morin method for 0.10 to 5.0 μg per 10 ml of solution is described. The effects of various impurities on the morin fluorescing complex and the significance of varying solution concentrations are discussed. (auth)

19266 (PG-Report-189) ANALYTICAL METHOD FOR THE DETERMINATION OF FLUORIDE IN AQUEOUS EFFLUENT (ABSORPTIOMETRIC-ALUMINIUM/HAEMATOXYLIN). (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 8p.

A measured volume of the effluent is made alkaline and evaporated to low bulk. Sulphuric acid is added and the solution is steam distilled. The fluoride content of the distillate is determined absorptiometrically by measuring the bleaching effect, of the fluoride ion, on an aluminum haematoxylin complex. The method is applicable to the determination of fluoride in aqueous effluents containing 0.1 to 2 ppm of fluorine. Concentrations outside this range may be determined by suitable adjustment of the sample volume or aliquot of the distillate used. The method has a

positive bias of 7% and a coefficient of variation of 10% at the 0.3 ppm level. (auth)

19267 (PG-Report-190) ANALYTICAL METHOD FOR THE DETERMINATION OF FLUORIDE IN MILK (ABSORPTIOMETRIC-ALUMINUM/HAEMATOXYLIN). (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 8p.

A measured volume of the milk is evaporated to dryness with calcium acetate and carefully ignited to remove organic matter. The residual ash is transferred to the flask of a steam distillation apparatus containing sulfuric acid and a small wad of glass wool. Fluoride is steam distilled from the solution as hydrofluosilicic acid into dilute sodium hydroxide solution. An aliquot of the distillate is buffered to a pH of 4.9 with ammonium acetate buffer solution, aluminum haematoxylin reagent is added and the bleaching of the purple color, by the fluoride ion, is measured using an absorptiometer. (auth)

19268 (PG-Report-191) ANALYTICAL METHOD FOR THE DETERMINATION OF FLUORIDE IN HERBAGE (ABSORPTIOMETRIC-ALUMINIUM/HAEMATOXYLIN). (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 8p.

The sample is mixed with calcium acetate and dried on a hot plate. The residue is then carefully ignited to remove organic matter and a known weight of the ash fused with sodium hydroxide. The melt is then dissolved in water and the solution transferred to the flask of a steam distillation apparatus containing sulfuric acid and a small wad of glass wool. Fluoride is steam distilled from the solution, as hydrofluosilicic acid, into dilute sodium hydroxide solution. An aliquot of the distillate is buffered to a pH of 4.9 with ammonium acetate buffer solution, aluminium haematoxylin reagent is added and the bleaching of the purple color, by the fluoride ion, is measured using an absorptiometer. (auth)

19269 (PG-Report-194) THE DETERMINATION OF 234-URANIUM IN ENRICHED URANIUM HEXAFLUORIDE, TETRAFLUORIDE AND OXIDE BY AN ALPHA-COUNTING TECHNIQUE. (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 7p.

Declassified version of IGO-AM/CA.84.

The sample is converted to a nitrate solution and, after suitable dilution, an aliquot is evaporated to dryness on a counting tray. The U^{234} content is calculated from the α activity of the residue after corrections have been applied for the activity of the other uranium isotopes present. The method is applicable to the determination of U^{234} in UF_6, UF_4, and UO_2. The presence of α emitters other than uranium will contribute to the result. The method as written can be applied to samples containing from 0.1 to 100% U^{234}. The method is quantitative with a coefficient of variation of $\pm 1\%$ over the concentration range. (auth)

19270 (TID-7606) ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. Fourth Conference, Gatlinburg, Tennessee, October 12-14, 1960. (Oak Ridge National Lab., Tenn.). 427p.

Thirty complete papers and 17 abstracts of papers presented at theFourth Conference on Analytical Chemistry in Nuclear Reactor Technology are given. The abstracts were included for papers to be published elsewhere. Separate abstracts were prepared for the 28 papers. Two were previously abstracted for NSA. (M.C.G.)

19271 (TID-7606(p.3-13)) DETERMINATION OF COBALT IN NUCLEAR REACTOR MATERIALS. A. F. Rosenberg, J. O. Hibbits, and R. T. Williams (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati).

A photometric method is described for the determination of Co in Be, BeO, and other nuclear materials. To eliminate interferences, Co was separated from other constituents by extraction or ion exchange methods, after which a Co-thiocyanate complex was formed in an acetylacetone medium. Co was then determined photometrically by measuring the absorbancy of the complex at 625 mμ. The results of interference studies are discussed. In the analysis of Be and BeO, only Cr and Mn, of 68 elements tested, were found to interfere at the 10 mg level. Methods are outlined for eliminating the interference of Cr and Mn as well as the diverse interferences which are encountered when this procedure is applied to the determination of Co in Nb, Ta, U, Th, and Zr. Experimental data are presented for the determination of Co in Be, BeO, and also in Nb, Ta, U, Th, and Zr. (auth)

19272 (TID-7606(p.14-29)) POLAROGRAPHIC DETERMINATION OF THE LANTHANIDES BY MEANS OF AZO DYESTUFFS. T. M. Florence and L. E. Smythe (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales).

An investigation into the polarographic behavior of 2,2'-dihydroxy azo dyes led to the development of a new method for the estimation of the lanthanides. The method is based on the effect of lanthanides on the polarographic reduction wave of Eriochrome Violet B (5-sulpho-2-hydroxybenzene-azo-2-naphthol). This dye exhibits well-defined, single polarographic reduction waves in many basic electrolytes. In NH_3, piperidine, and similar buffers, the lanthanides cause a reduction in wave height of the dye, and a second wave appears at a more negative potential. The height of the second wave is proportional to the concentration of lanthanide, and its potential becomes more negative with increasing atomic number of the lanthanide. The nature of the lanthanide-dye complexes and of their reduction products was investigated extensively by d-c and a-c pen polarography, linear-sweep cathode ray polarography, and controlled-potential coulometry. Spectrophotometry was also used in an attempt to elucidate the structure of the complexes and to determine conditional stability constants. The analytical method is subject to several interferences, but these can be overcome by pH control, use of masking agents, or quick separations. (auth)

19273 (TID-7606(p.30-50)) THE DETERMINATION OF DISSOLVED GASES IN HIGH-TEMPERATURE HIGH-PRESSURE WATER SYSTEMS. G. M. Allison, I. H. Crocker, and J. F. Atherley (Atomic Energy of Canada Ltd Chalk River Project, Chalk River, Ont.).

This paper was previously abstracted as CRRL-982 and appears in NSA, Vol. 15, abstract no. 5953.

19274 (TID-7606(p.51-63)) THE SPECTROGRAPHIC DETERMINATION OF TRACE ELEMENTS IN HUMAN TISSUE. S. R. Koirtyohann and C. Feldman (Oak Ridge National Lab., Tenn.).

An Atomic Energy Commission program for the determination of trace elements in human tissues is discussed. Direct-reading spectrometry, mechanical electrode loading, and other special techniques are being utilized to expedite analysis. The purpose of the program is to determine normal concentration ranges in human tissues, for as many elements as possible, as an aid in establishing maximum permissible concentrations of radioactive isotopes in the human body. The tissues are frozen for shipping and storage. They are then dissected to remove excess fat, connective tissue, etc., and dried at 110°C. The dried sample is ground and a small protion (1 to 2 g) is ashed at 450°C. Odors from the drying and ashing processes are

avoided by combustion of the exhaust gases. Spectrometric examination of the ash is performed, by d-c arc excitation. A jet, operated with a mixture of He and O_2, is used to stabilize the arc and to reduce background levels. The resulting arc gives variations in the general exposure of about 7%, and background variations are normally less than 10%. Average deviations of element/Pd intensity ratios range from about 2% for Sr and Ba to 8% for Zr, with most of the other elements near 5%. Detection limits (taken as the concentration in the ash giving a reading of 1.5 times background) range from 0.5 ppm for Be to 300 ppm for Zn. (auth)

19275 (TID-7606(p.64-72)) DETERMINATION OF TRACE QUANTITIES OF FISSION PRODUCTS IN NONIRRADIATED NATURAL AND DEPLETED URANIUM SALTS. P. K. Duroda and M. P. Menon (Arkansas. Univ., Fayetteville).

The occurrence of a number of fission products in pitchblende and in nonirradiated natural and depleted U salts with 10^{-4} disintegration/sec per gram of U, was recently reported by Kuroda and co-workers. The following nuclides were detected: $Sr^{89, 90, 91, 92}$, Mo^{99}, $I^{131, 132, 133, 134, 135}$, and Ba^{140}. These fission products are formed predominantly by the spontaneous fission of U^{238}, and it is possible to obtain the general shape of the mass-yield curve for the spontaneous fission of U^{238} from the equilibrium activities of the fission products found in nonirradiated U salts. The spontaneous fission half-life of U^{238} can also be calculated from these data. Radiochemical procedures were developed for the determination of each fission product, in which a quantity ranging from 0.1 to 1 disintegration/sec of the fission-product activity is isolated from kilogram quantities of U salts, purified, and then counted. Where the half-life of the fission product was several months, U minerals, instead of U salts, were used. Removal of the bulk of the U by a liquid extraction method was found to be necessary and/or advantageous in most cases, although it was possible to precipitate certain fission products directly from a concentrated solution of the U salts. A new procedure is currently under investigation for the isolation and quantitative determination of the isotopes of Ce by a liquid-liquid extraction method. Ce(IV) can be extracted from a 10M HNO_3 solution by a 1 to 4 mixture of TBP and CCl_4 with high extraction efficiency, and further purified by a combination of oxidation-reduction and liquid-liquid extraction procedures. (auth)

19276 (TID-7606(p.81-99)) DETERMINATION OF U^{235} IN LOW-ENRICHED, NON-IRRADIATED URANIUM DIOXIDE PELLETS BY GAMMA-RAY SPECTROMETRY. C. A. Meinz and B. D. La Mont (Westinghouse Electric Corp., Pittsburgh).

A rapid, nondestructive method was developed for determination of the U^{235} content of UO_2 pellets, through the application of gamma spectrometry. The 184-kev gamma ray produced by the U^{235} nuclide is utilized for making a direct measurement of the U^{235} content of pellets. A statistical study was made of this method, in which it was demonstrated that, at the 3% U^{235} level, the relative standard deviation is 0.03%. As a routine procedure for the isotopic assay of nonirradiated U in the concentration range of 1 to 10% U^{235}, gamma spectrometry was found to be most economical method known. (auth)

19277 (TID-7606(p.100-11)) ANALYSIS OF URANIUM OXIDE FUEL MATERIALS. R. W. Bane (Argonne National Lab., Ill.).

Chemical methods for the analysis of uranium oxide containing mixtures that were used as fuel elements or that have potential applications in reactor technology are described. The determination of uranium in the ThO_2-UO_2 ceramic fuel that was used for the Borax-IV loading was accomplished by dissolving the ceramic in HNO_3 with a trace of F^-, reducing the uranium, and titrating it with a standard Ce(IV) solution. The EBWR "spike" pellets of $ZrO_2-CaO-UO_2$ were dissolved in HCl, using the sealed tube technique. Uranium was determined volumetrically; calcium was precipitated with oxalate and determined gravimetrically or volumetrically; zirconium was determined by a gravimetric method. The graphite–urania fuel matrix for TREAT was analyzed by ashing it at 850°C, dissolving the residue, and determining the uranium volumetrically or colorimetrically. The cermet of $Al-U_3O_8$, used as fuel in the Argonaut reactor, was analyzed for uranium by volumetric method. A density measurement was utilized by the metallurgists for verifying the composition of each plate prior to loading the reactor. A ceramic composed of $La_2O_3-UO_2$, which is now in the research phase as a possible fuel, was analyzed for uranium by a volumetric method. Lanthanum was determined, after an ion-exchange separation, by precipitation with oxalate. Uranium sulfide was analyzed for S^{2-} by an evolution-volumetric method, total S by an oxidation-gravimetric procedure, and uranium by a gravimetric method. Other uranium mixtures of interest include UO_2–polystyrene, UC, UO_2-MgO, UO_2-ZrO_2, $UO_2-Al_2O_3$, $UO_2-Nd_2O_3$, UO_2-CaO_3 and UO_2–glass. (auth)

19278 (TID-7606(p.112-19)) THE CHEMICAL DETERMINATION OF BORON IN BORON CARBIDE–ZIRCONIUM. J. Rynasiewicz and V. F. Consalvo (Knolls Atomic Power Lab., Schenectady, N. Y.).

A rapid method is described for the dissolution and chemical determination of B in B_4C-Zr. The sample is dissolved in a mixture of HF plus HCl contained in a Pt dish which is cooled in a bed of dry ice. Approximately 96 to 99% of the total B remains undissolved. This residue is filtered off, ashed, and fused with Na_2CO_3, and the B is then determined according to the classical mannitol titration method. The acid-soluble B is determined by modified mannitol titration after separating the Zr and other interfering cations with $BaCO_3$. The acid-insoluble and acid-soluble B are added to give the total B in the sample. The precision of this method was estimated from the analysis of synthetic mixtures of "standard" B_4C and Zr. At the 2% B_4C level or higher, the precision, on a relative basis, is about 1% for a single measurement, at the 95% confidence level. "Standardization" of the B_4C sample was performed by analyzing for B, C, and impurities. A mass balance of 100.2 ± 0.7% was obtained. (auth)

19279 (TID-7606(p.120-9)) THE DETERMINATION OF CARBON IN LITHIUM. J. R. Potts and E. W. Hobart (Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.).

Methods are reported for the determination of C in Li by measurement of acetylene which, presumably, is produced when Li contaminated with C is dissolved in water. Unreasonably low results were obtained by measurement of acetylene. Consequently, the assumptions made in the development of this method were examined critically. These assumptions are: that all C present in Li is combined as Li_2C_2 and, therefore, that even trace amounts of C in Li will produce acetylene quantitatively when reacted with water. Considerable doubt is cast on these assumptions by the experiments reported in this paper. The total C contents of gases evolved during the dissolution of Li samples in CO_2-free water were determined. No measurable amounts of C were evolved from Li samples containing normal levels of

C contamination. However, upon acidification of the resultant LiOH solution significant amounts of CO_2 were produced. Acetylene was produced only when Li highly contaminated with C was dissolved. In view of the uncertainties involved in any analytical approach based on specific products of the reaction of Li with water, microcombustion techniques were examined. A method involving oxidation of all gases released during dissolution and acidification of Li samples, and a method involving direct combustion of Li samples were investigated for the determination of C in Li. (auth)

19280 (TID-7606(p.130-9)) ANALYSIS OF TANTALUM AND LUTETIUM IN IRRADIATED HAFNIUM. R. F. Dufour (Knolls Atomic Power Lab., Schenectady, N. Y.).

This paper was previously abstracted in KAPL-2000-11 (p.I.1.I.2) and appears in NSA, Vol. 15, abstract no. 2587.

19281 (TID-7606(p.140-51)) ANALYSIS OF TRACE IMPURITIES IN HELIUM USING GAS CHROMATOGRAPHIC TECHNIQUES. J. Malgiolio, E. A. Limoncelli, and R. E. Cleary (Pratt and Whitney Aircraft Corp., Middletown, Conn.).

A gas chromatographic method is described for the quantitative separation and determination of argon, oxygen, nitrogen, carbon monoxide, and methane in helium at the one-volume-per-million level. Standard gas samples, prepared by PVT techniques were used to calibrate the chromatograph. The chromatographic unit includes a Linde 5-A Molecular Sieve as the column adsorbent and thermistor-type thermal conductivity cells as detectors. Data are presented comparing the performance of the Molecular Sieve with that of activated charcoal as column materials. This analytical technique was used to evaluate methods for helium purification. Two systems were investigated: a Linde 5-A Molecular Sieve-hot Titanium system and a cryogenic activated charcoal system. The exit gas was analyzed to correlate purity with flow rates and temperature conditions in the purifiers. (auth)

19282 (TID-7606(p.152-7)) THE POLAROGRAPHIC DETERMINATION OF NIOBIUM IN ZIRCONIUM-BASE ALLOYS. D. P. Stricos (Knolls Atomic Power Lab., Schenectady, N. Y.).

A polarographic method is presented for the analysis of Nb in Zr-base alloys containing Sn. The sample is dissolved in a mixture of H_2SO_4, HCl, and HBF_4 and then fumed with H_2SO_4. The resulting H_2SO_4 solution is diluted to volume, and the Nb is determined polarographically by measuring the peak height of its wave at -0.95 v vs SCE, using a cathode-ray polarograph. (auth)

19283 (TID-7606(p.158-73)) GAS CHROMATOGRAPHIC DETERMINATION OF HELIUM IN NEUTRON-IRRADIATED BERYLLIUM OXIDE. A. S. Meyer, Jr., J. C. White, and I. B. Rubin (Oak Ridge National Lab., Tenn.).

A method was devised for the separation and determination of micro quantities of helium in beryllium oxide that was irradiated in nuclear reactors. As little as 3 ppm of helium were separated and subsequently determined by gas-solid chromatography. From the quantities so far tested, it is indicated that fractional parts per million of helium can be separated and determined. The beryllium oxide samples, approximately 14 g each, which were obtained as cylindrical pellets, were digested for 24 hours in a HF-KF mixture at a temperature of 120 to 130°C in an evacuated, silver-plated, copper vessel. At the end of the digestion period the reaction vessel, as well as a trap, was cooled to liquid nitrogen temperature and the non-condensable gases were pumped off through a vacuum manifold into twin sample bulbs. The gas in one bulb was retained for mass spectrometric analysis. The gas in the other bulb was cycled through a hot copper oxide tube and a cold trap in order to convert any tritium and hydrogen to water. This bulb was then transferred to a second vacuum manifold, and the gas was pumped into a 1-cc transfer loop which was designed for the injection of gas samples into a vapor fractometer. The helium was then determined gas chromatographically, using nitrogen as the carrier gas, and Linde 5A Molecular Sieve in a column which was 8-feet long and $\frac{3}{8}$-inch outside diameter. (auth)

19284 (TID-7606(p.185-94)) SOME APPLICATIONS OF ANION EXCHANGE-SPECTROGRAPHIC PROCEDURES IN A NITRIC ACID MEDIUM. J. P. Faris and R. F. Buchanan (Argonne National Lab., Ill.).

The adsorption characteristics of some 60 elements in HNO_3 media were studied with a strong-base ion exchange resin. Both column elution and batchwise procedures were used. Application of optical and emission spectrographic techniques in conjunction with chemical and radiochemical analyses resulted in a considerable saving of analytical effort. Spectrographic examination of column effluents was relatively rapid because, with this method of analysis, elements can be added simultaneously to resin columns and the need for many tracer preparations is eliminated. Most elements were not adsorbed in the range of acid concentrations studied (1 to 14M). An adsorption maximum at approximately 8M HNO_3 was noted for Np(IV), Pa(V), Pu(IV), Th(IV), and U(IV), while the adsorption of Au(III), Bi(III), Hg(II), Pd(II), and Re(VII) decreased at acid concentrations greater than 2M. The high anionic adsorption of Th and Np in HNO_3 was used for the separation of impurities prior to their spectrographic determination. Analyses of microgram quantities of about 50 elements were made after adsorbing a sample on an anion exchange resin. The relatively rapid and simple procedure is applicable to routine trace element analyses. (auth)

19285 (TID-7606(p.195-205)) THE USE OF A GLASS-BEAD COLUMN IMPREGNATED WITH TRI-N-OCTYLPHOSPHINE OXIDE FOR THE ADSORPTION OF URANIUM FROM URINE. William C. Dietrich, John D. Caylor, and Eric E. Johnson (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.).

A method is presented for the separation of U from urine. U is adsorbed from partially digested urine onto a column of glass beads coated with tri-n-octylphosphine oxide and then stripped from the column with alcohol. The alcoholic solution is then evaporated and ashed, and the alpha activity is determined by counting. The adsorption, stripping, and evaporation sequences are accomplished automatically by an apparatus designed for that purpose. The average recovery of U, which includes extraction efficiency, alpha attenuation, and counter variability, is 73%. The absolute standard deviation is 10%. (auth)

19286 (TID-7606(p.206-16)) SEPARATION OF STRONTIUM FROM ALKALINE EARTHS AND FISSION PRODUCTS. G. Samos (Martin Co. Nuclear Div., Baltimore).

A method was established for the separation of gram quantities of Sr from Ca and Ba, and from fission-product contaminants found in an Sr^{90} source solution obtained from the F3P main stream at Oak Ridge National Laboratory. The ion-exchange chromatographic method was modified and extended to give clean-cut separations of Ca and Sr that eliminated the "tailing off" of Sr. Dowex 50-X12 resin was used for the separation of Sr from Ca, Ba, and a majority of fission products. The remainder of the fission-product contaminants are removed with IR-400 resin. (auth)

19287 (TID-7606(p.221-31)) RADIOCHEMICAL ANALYSIS OF KRYPTON-85. B. F. Rider and J. P. Peterson, Jr. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

For the radiochemical analysis of Kr^{85} by absolute gamma spectrometry, a knowledge of its gamma branching ratio is required. The 0.513-Mev gamma to beta ratio in Kr^{85} was found to be 0.0036 ± 0.0008. (auth)

19288 (TID-7606(p.232-45)) APPLICATION OF CONVERSION X-RAY SPECTRA TO ISOTOPIC ANALYSIS. RESOLUTION OF MIXTURES OF Ru^{106}–Rh^{106} AND Ru^{103}. S. J. Tassinari and H. L. Finston (Brookhaven National Lab., Upton, N. Y.).

Ru^{103} and Ru^{106}-Rh^{106} activities in a mixture of the isotopes were determined by analyzing both the gamma spectrum and x-ray spectrum of the mixture. The gamma spectrum of Ru^{103} exhibited a photopeak at 500 kev, while Ru^{106}-Rh^{106} showed peaks at 510, 620, 740, and 870 kev. Assay for Ru^{106}-Rh^{106} was obtained from the area under the 620-kev photopeak. Ru^{106}-Rh^{106} exhibited no x ray, while Ru^{103} showed a 20-kev x ray resulting from the internal conversion. This was utilized for the assay of Ru^{103}. (auth)

19289 (TID-7606(p.248-52)) THE DETERMINATION OF MERCURY IN LITHIUM HYDROXIDE AND LITHIUM CARBONATE BY ACTIVATION ANALYSIS. W. N. Crofford and T. A. Kovacina (Naval Research Lab., Washington, D. C.).

An investigation was undertaken to determine the magnitude of the Hg contaminant present in LiOH. Hg may be contained in the raw Li minerals, retained in the refining process, and introduced during the process of separating Li isotopes. The potential release of Hg into a breathing atmosphere, perhaps through some anomalous scrubbing mechanism, and its characteristic toxicity were of considerable concern in this program. As a consequence, interest was provoked to develop sensitive analytical methods for the quantitative detection of minute amounts of Hg in LiOH. Because of the attractive nuclear characteristics of Hg, activation analysis was investigated as a means of determining Hg. A detailed account of a comparator method is described. Replicate samples of both LiOH and Li_2CO_3 were irradiated in the NRL Reactor for the purpose of determining the amount of Hg present initially in the hydroxide and finally in the carbonate so that information might be gained concerning the fate of the Hg in the scrubbing process. A detailed procedure is described for the irradiation and analysis of the samples, using the radiochemical-carrier technique. Interferences from extraneous induced activity and their subsequent removal are discussed. The principal contaminants are tritium, F^{18}, P^{32}, and Na^{24}. The Hg content is determined by measuring the activity of the Hg^{197m} and Hg^{203} isotopes induced by the (n,γ) reaction. The quantity of Hg in the aforementioned Li compounds was found, by activation analysis, to be of the order of 1 to 2 ppm. (auth)

19290 (TID-7606(p.259-67)) PLASMA-JET EXCITATION OF URANIUM HEXAFLUORIDE. L. E. Owen (Goodyear Atomic Corp., Portsmouth, Ohio).

In the application of emission spectroscopic techniques to the isotopic assay of U at the Goodyear plant, it was initially specified that direct spectral excitation of gaseous UF_6 be utilized. In the method presently in use, a plasma jet is utilized as a spectroscopic source. In the stabilized version of the plasma jet, UF_6 is fed into the center of a plasma discharge. The excited spectra are obtained from the radiation of the "flame," 5 mm in height, which forms at the jet orifice. This "flame" has little internal structure. In appearance, the "flame" resembles a radiating tube enclosing a rod radiating at a slightly lesser intensity. The projected image, therefore, is somewhat less intense in the center than at the edges. A slightly better signal-to-noise ratio, however, is available from the central radiation. Optical alignment is simple and noncritical. Samples are obtained by freezing out UF_6 on the walls of a small trap. The UF_6 is then carried into the jet for excitation by a modest flow of He (10 to 30 ml/min). This flow rate is sufficient to sweep the sample into the jet because of the appreciable vapor pressure of UF_6 at room temperature. Additional He is introduced into the sample stream beyond the trap, diluting the sample and speeding it to the excitation zone. Ten to thirty ml of UF_6 is consumed per minute in average excitations. This consumption rate is independent of the size and configuration of the sample trap but is primarily a function of flow rate of the sweep-gas. While direct-current excitations, utilizing currents of from 10 to 30 amp, are practical, experience indicates that a plateau of optimal currents is centered around 20 amp for the units used. By utilizing a gas-handling system designed for the alternate analysis of two gas samples, standard and unknown samples can be compared. Cross contamination or "memory" is not exhibited. In tests of the plasma jet source on the ORGDP direct-reading spectrometer, the output was sufficiently constant to permit the recording of a wavelength scan in real time. Such stability makes possible its use with sequential as well as parallel readouts. The device is now available as a radiation source for UF_6 samples in an isotopic direct-reading system. Its performance will be checked with several spectrometers and readout schemes before a complete instrument is specified. Consideration is also being given to the source for continuous monitoring applications. (auth)

19291 (TID-7606(p.268-75)) CHROMATOGRAPHIC ANALYSIS OF RADIOACTIVE GASES. W. R. Kritz (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

Failures of the cladding on metallic U fuel elements are signaled by release of radioactive fission products. The noble gases Kr and Xe are among the first of the radioisotopes to enter the coolant, and provide convenient "rupture" signals for suitable monitors. Significant amounts of radioactive gases are normally produced in the coolant by irradiation of dissolved air. These radioisotopes present a troublesome noise level for conventional activity monitors, and a large increase in noble-gas activity is usually required for reliable rupture detection. Gas chromatographic rupture monitors can be used to provide high signal-to-noise ratios by separating gases into relatively pure fractions, discarding the irradiated air, and measuring traces of noble-gas fission products with beta-sensitive detectors. Radioactive gases are stripped from the reactor coolant with He, which is then dried and piped to a monitor. A sequence control actuates threeway solenoid values to inject samples of the stripped gas into a chromatographic column at preset intervals. This column is a section of aluminum tubing (60 in. long, 0.25-in. OD, 0.035-in. wall), which is packed with 20 to 50 mesh particles of Linde Molecular Sieve type 5A, and coiled to a 4-in.-diameter spiral. The samples are eluted from the column with fresh He and emerge through discriminator values to a gas-counting cell. The sequence control can be set to discard N_2 and O_2-Ar fractions by timed operation of the discriminator values. The instrument will respond to Ar, Kr, and Xe radioisotopes. A prototype monitor,

model 1 GC rupture monitor, gave very good performance during four months of continuous laboratory testing and 11 months of field service. The design of the model 2 GC rupture monitor was based on these tests. With the exception of the automatic chromatograph assembly, which may easily be assembled from standard parts, all components of the model 2 are available commercially. (auth)

19292 (TID-7606(p.291-310)) CONTINUOUS ANALYSIS OF RADIOACTIVE GAS AND LIQUID STREAMS. James I. McEwen (Mine Safety Appliances Co., Pittsburgh).

Instrumentation for continuous analysis is discussed. In gas- and liquid-stream analysis sampling and measuring techniques vary widely in most instances. There are some methods of analyzing the two types of streams which do overlap in type of instrumentation but only in rare instances in technique as well. The instruments for continuous gas and liquid analysis include on-stream analyzers for measurement of components in the following ranges: percentage, parts per million, and parts per billion. The techniques used in each of these ranges are described. In general, those methods of analysis are emphasized which deal with the determination of components in the ppm and ppb range. The analytical techniques cover measurement of gases in gas streams, gases in liquids, liquids in liquids, and dissolved solids in liquids. (auth)

19293 (TID-7606(p.330-43)) A CONTINUOUS STRIPPER FOR THE DETERMINATION OF DISSOLVED GASES AND FISSION-PRODUCT GASES IN HIGH-TEMPERATURE AND -PRESSURE WATER SYSTEMS. S. P. Gibson, G. M. Allison, and J. F. Atherley (Atomic Energy of Canada Ltd., Chalk River, Ont.).

A gas stripper device and procedure are described for making continuous, semicontinuous, and spot determinations of dissolved gases in high-temperature and -pressure water systems. Two of the gases, N_2 and H_2, are determined by gas chromatography, using a Vapor Fractometer. The concentrations of Xe^{133}, Xe^{138}, and Kr^{88} in the gases are determined by gamma spectrometry. The techniques involved in these analyses are discussed. Data are presented to show that 95% of the N_2 and H_2 plus 90% of the fission-product gases are removed by this continuous stripping process. (auth)

19294 (TID-7606(p.353-66)) FACILITIES FOR CHEMICAL ANALYSIS AT THE AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT. L. E. Smythe (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales).

Organization and facilities for chemical analysis suitable for smaller atomic energy research establishments are considered in some detail. In order to conserve staff, avoid unnecessary duplication of equipment, ensure effective organization and record keeping, promote close liaison and interchange of ideas within the various branches of analytical chemistry, and ensure adequate knowledge of analytical chemistry literature and research work, it was decided to organize one central analytical chemistry service and research group for the whole research establishment. The group is organized around major items of instrumentation, closely integrated with conventional methods of gravimetric and volumetric analysis, which often precede an instrumental method. The more important facilities available in the group include: spectrometry (emission, infrared, mass, and x-ray); electrochemistry (polarography, coulometry, titrimetry); ultraviolet and visible spectrophotometry; chromatography (including gas chromatography); a wide range of counting equipment (including vacuum-fusion analysis of gases in metals); and instrumentation associated with techniques of solvent extraction, ion exchange, and the analysis of highly active solutions. Details are given of simple records and literature reference systems maintained by the group. Staff requirements, service and research work loadings, and some of the current analytical chemistry work in relation to the current program of the research establishment are also presented in some detail. (auth)

19295 (TID-7606(p.367-90)) CALDER-HALL TYPE REACTOR COOLANT: ANALYTICAL REQUIREMENTS AND PROBLEMS. R. W. Dickinson, E. Hughes, A. R. Newcombe, R. C. Williams, and F. J. Woodman (United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England).

Calder-Hall type reactors using CO_2 as gaseous coolant call for analytical control of the quality of the liquid CO_2 used as the raw feed material and subsequent analysis of the circuit gas under startup, shutdown, and normal operating conditions. An outline is given of sampling techniques and analytical procedures both for the examination of the feed gas and for the circuit gas; methods for B, moisture, oil, C^{14}, CO, and other gaseous impurities are described briefly, and some typical analytical data are presented. Techniques involved include mass spectrometry, liquid scintillation beta counting, and infrared absorption. A short description is given of "in-line" instrumentation for the continuous measurement of moisture and CO. Finally, a summary is given of work, still in progress, on the application of gamma-spectrometry to the study of radioactive species, some very short lived, that are present in the circuit-gas; the development of preliminary separation and concentration procedures, using, for example, Molecular Sieve materials, is also outlined. (auth)

19296 (TID-7606(p.392-404)) THE USE OF ATOMIC WEIGHTS IN URANIUM MEASUREMENTS. J. C. Barton (Oak Ridge Gaseous Diffusion Plant, Tenn.).

Uranium accountability at large installations requires many measurements of U, both chemical and isotopic. A source of differences in measurements resulted from the nonuniform application of atomic weights, particularly of U. The old chemical atomic weight for U was recently abandoned in favor of a scheme based upon the physical atomic weights of the individual isotopes. Not only is this new method more accurate but it can be applied in a uniform manner to the analysis of U of any isotopic composition. It will eliminate biases due to atomic weight discrepancies among the participants. (auth)

19297 (TID-7606(p.405-9)) STANDARDIZATION IN RADIOISOTOPES AT THE INTERNATIONAL LEVEL. W. S. Lyon (Oak Ridge National Lab., Tenn.).

The need for standards in the nuclear field has become more and more apparent during recent years with the increasing use of nuclear reactors and radioisotopes. Standardization groups in individual countries have met and are continuing to meet this problem on a national level; in addition, many are attempting to work out international solutions by acting through the International Standards Organization (ISO) which is the international representative of many national organizations. There are in addition a number of other organizations (e.g., the International Commission on Radiochemical Units of Measurement, International Union on Pure and Applied Physics, World Health Organization, and International Atomic Energy Agency) which are active in this work, often only in a specialized area, however. The work of a number of these organizations is discussed briefly together with a somewhat more detailed account of the program of the ISO for setting standards in nuclear nomenclature, reactor safety, radiation protection, and radioisotopes. (auth)

19298 (TID-7606(p.410-19)) PROBLEMS IN GRAVIMETRIC DETERMINATION OF URANIUM IN URANIUM TRIOXIDE. C. A. Kienberger (Oak Ridge Gaseous Diffusion Plant, Tenn.).

Large accountability and monetary discrepancies in the Atomic Energy Commission's operations can result from several major sources of error in the gravimetric determination of the uranium in uranium trioxide. These sources of possible bias are the atomic weight used for uranium, adsorption of moisture, and use of the incorrect gravimetric factor for uranium in the black oxide. Errors from these sources can be minimized by using physical measurements converted to the chemical atomic weights; a dry atmosphere for blending, subsampling, and weighing; and a gravimetric factor based on titration. (auth)

19299 (TID-12898) AN ADSORPTION-CONTROLLED ANODIC PROCESS AT THE GRAPHITE ELECTRODE: APPLICATION TO THE DETERMINATION OF MINUTE AMOUNTS OF NONIONIC SURFACTANTS. Report No. 61. Phillip J. Elving and David L. Smith (Michigan. Univ., Ann Arbor). May 1, 1961. Contract AT(11-1)-70. 26p.

In the presence of nonionic surface-active agents, such as the polyoxyalkalene ether type, an anodic voltammetric wave having a peak potential of about 1.35 v. versus the S.C.E. appears at the graphite electrode. The effect of various experimental conditions on the magnitude of the peak current is reported, in particular, the variation with surfactant concentration. The most extensive data are presented for the alkylated aryl polyether alcohol, Triton X-100, since it is widely used in polarography. Adsorption of the nonionic surfactant on the electrode surface precedes the current-producing process; it is postulated that the amount adsorbed varies directly with the peak current observed, which is most likely due to the catalytic evolution of oxygen with the concomitant desorption of the surfactant film. This mechanism is supported by a study of the cloud point behavior of the surfactant, the negative temperature coefficient of the peak current, and concentration and stripping experiments. The voltammetric wave can be used for the determination of very small amounts of the Tritons. Concentrations of 0.001 to 0.01 weight-% Triton X-100 can be estimated to ±5%; this corresponds to 0.1 to 1 mg. in a 10-ml. test solution. (auth)

19300 (WAPD-M(GLA)-701-2(Rev.2)) THE DETERMINATION OF THE SECONDARY IMPURITIES IN HAFNIUM BY EMISSION SPECTROGRAPHIC ANALYSIS. J. F. Frain, J. R. Ryan, and R. F. Farrell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 18, 1960. Contract AT-11-1-GEN-14. 8p.

A procedure is presented for analysis of hafnium metal after conversion to the oxide. (J.R.D.)

19301 (AEC-tr-4569) STUDY OF A UF_6 IONIZATION CHAMBER. J. Schmets, G. Calleri, and R. Bellie (Brussels. Centre d'Étude de l'Énergie Nucléaire). Translated by Martha Gerrard from report BLG-54. Nov. 25, 1960. 21p.

The ionization produced by UF_6 α particles on itself in the gaseous state was measured. The corresponding calculations were made by two different methods and extended to mixtures of UF_6 and a diluting gas. Good agreement between digital computer calculations and the experimental results was observed. Such measurements can be applied to the continuous detection and determination of UF_6 in industrial installations. (auth)

19302 (CEA-tr-A-916) DETERMINATION DE L'URANIUM A L'AIDE DE CUPFERRON EN PRESENCE DU SEL D'AMMONIUM DE L'ACIDE ETHYLENEDIAMINETETRACETIQUE. (Determination of Uranium with Cupferron in Presence of Ammonium Salt in Ethylenediaminetetraacetic Acid). B. Bieber and Z. Vecera. Translated into French from Collection Czechoslov. Chem. Communs., 24: 1074-8(1959). 25p.

This paper was previously abstracted from the German language and appears in NSA, Vol. 13, abstract no. 13341.

19303 (JPRS-9293(p.183-91)) RADIOACTIVATION ANALYSIS OF PURE MATERIALS AND PROSPECTS OF ITS DEVELOPMENT. V. I. Baranov, Yu. A. Surkov, G. M. Chernov, and Yu. V. Yakovlev. Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 5: 570-3(Oct. 1960).

The use of activation analysis to determine the impurities in pure materials used in semiconductor technology and reactor construction is discussed. In the method of gamma spectroscopy, a study of the spectrum obtained makes it possible to determine the qualitative purity of the separation according to the energies of the characteristic gamma rays and to quantitatively determine the impurities present in the sample by the areas of the parts of the spectrum corresponding to the activated isotope of the impurity. Results of investigations of impurities in silicon, thallium, and graphite are presented. The use of a fast stream of neutrons to determine certain impurities is discussed. (M.C.G.)

19304 (NP-tr-602) THORIN: AN INTERESTING CHROMOGENIC AGENT AND CHELATOCHROME INDICATOR. M. B. Johnston, A. J. Barnard, Jr., and W. C. Broad. Translated from Rev. univ. ind. Santander, 2: 137-46(1960). 14p.

A literature search was made of the uses of Thorin as a chromogenic agent for the detection and determination of thorium, uranium(IV), plutonium(IV), zirconium, beryllium, and lithium, and as a chelatochrome indicator in the precipitation titration of sulfate and in various EDTA titrations effected in acidic media. 102 references. (auth)

19305 DETERMINATION OF RADIOANTIMONY BY EXTRACTION INTO DIISOBUTYLCARBINOL. R. W. Lowe, S. H. Prestwood, R. R. Rickard, and E. I. Wyatt (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 874-6(June 1961).

A liquid-liquid extraction procedure is used for removing radioantimony from fission products. The Sb is extracted from an acid medium with a diisobutylcarbinol-n-heptane mixture and is stripped from the organic phase with NaOH for counting. (auth)

19306 CATION EXCHANGE SEPARATION OF METAL IONS BY ELUTION WITH HYDROFLUORIC ACID. James S. Fritz, Barbara B. Garralda, and Shirley K. Karraker (Ames Lab., Ames, Iowa). Anal. Chem., 33: 882-6(June 1961).

A cation exchange technique is used for the separation of metal cations. The sample is dissolved in acid and applied to the column. The individual cations are eluted with HF. Elution patterns varied with variation in concentration of the eluent. (auth)

19307 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM BY THIOCYANATE. W. L. Belew, G. R. Wilson, and L. T. Corbin (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 886-8(June 1961).

A simple and accurate spectrophotometric method is devised for determining Ru. The Ru is oxidized to tetroxide form and extracted with $CHCl_3$. It is stripped from the extracting solvent with NaCNS and the ruthenium thiocyanate complex is formed. Maximum absorbance is measured at 590 mμ. (auth)

19308 FLUORESCENT X-RAY SPECTROMETRIC DETERMINATION OF SCANDIUM IN ORES AND RELATED MATERIALS. Robert H. Heidel and Velmer A. Fassel (Ames Lab., Ames, Iowa). Anal. Chem., 33: 913-16(June 1961). (IS-23)

A direct method for determining Sc in ores, process materials, and rare earth mixtures uses fluorescent x-ray spectrometry. Accurate results are obtained using an internal standard of V_2O_5. Results are compared to results obtained by optical emission and photometric titration techniques. (auth)

19309 POLAROGRAPHY OF NIOBIUM(V) IN (ETHYLENEDINITRILO)-TETRAACETIC ACID AND CITRIC ACID MEDIA. John H. Kennedy (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). Anal. Chem., 33: 943-6(June 1961).

Polarographic data are obtained for three niobium-citrate complexes and one niobium-EDTA complex. EDTA medium is not considered suitable for determination of Nb, but the use of strong citric acid medium at pH 3 yields reproducible results. Niobium is polarographically determined in the presence of phosphate ion, Ta, Mo, and Tl. (auth)

19310 ANODIC CHRONOPOTENTIOMETRY AT A LIQUID BISMUTH ELECTRODE IN FUSED LITHIUM CHLORIDE–POTASSIUM CHLORIDE. John D. Van Norman (Brookhaven National Lab., Upton, N. Y.). Anal. Chem., 33: 946-8(June 1961).

Anodic processes at a liquid Bi alloy electrode are studied for the development of methods of analysis for small amounts of metals dissolved in Bi. Chronopotentiograms are obtained for Zn and Li dossolved in a liquid Bi electrode. Analytical performance indicates an accuracy of ±4%. (auth)

19311 COLORIMETRIC DETERMINATION OF NEPTUNIUM WITH THORIN. R. D. Britt, Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Anal. Chem., 33: 969-70 (June 1961).

Np^{4+} forms a colored complex with thorin that has a molar absorptivity of 14500 at 540 mμ. The complex is sufficiently stable to be used in determining Np to a precision of ±2.1% for 0.63 μg/ml and ±4.0% for 5.09 μg/ml. (auth)

19312 QUARTZ FLOW CELLS FOR CONTINUOUS SPECTROPHOTOMETRIC ANALYSIS OF COLUMN EFFLUENTS. N. G. Anderson (Oak Ridge National Lab., Tenn.). Anal. Chem., 33: 970-1(June 1961).

An improved method is given for the quantitative spectrophotometric analysis of liquid chromatographic column effluents containing ultraviolet-absorbing materials. Suitable quartz cells and a two-cell holder for the Beckman DU spectrophotometer are described. Such cells have been in continuous use for over six months. (P.C.H.)

19313 COMPLEXOMETRIC TITRATION OF URANIUM (IV). J. Korkisch (Universität, Vienna). Anal. Chim. Acta, 24: 306-10(Apr. 1961). (In German)

A complexometric titration is described for the determination of U^{4+}. Solochrome Black 6BN is used as indicator. The reduction of U^{4+} is performed with zinc in hydrochloric acid solution. (auth)

19314 MICRO-DETERMINATION OF TRACES OF COBALT IN CEMENTS BY SPECTROPHOTOMETRY. W. Haerdi, J. Vogel, and D. Monnier (Université, Geneva). Anal. Chim. Acta, 24: 365-70(Apr. 1961). (In French).

The determination of traces of cobalt in cements by spectrophotometric determination with nitroso-R salt following an exchange resin separation is described. (auth)

19315 THE DETERMINATION OF PLUTONIUM BY MASS SPECTROMETRY USING A [242]-PLUTONIUM TRACER. R. K. Webster, A. A. Smales, D. F. Dance, and L. J. Slee (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Anal. Chim. Acta, 24: 371-80(Apr. 1961). (AERE-R-3327). (In English)

An isotopic dilution method is described for determining Pu in samples of irradiated U using a Pu^{242} tracer. An aliquot of tracer is added to the sample and the mixture treated to ensure isotopic exchange; Pu is then separated by ion exchange and an isotopic analysis made using an M.S.$_5$. mass spectrometer. The precision (3 σ) for an aliquot containing 0.1 μg Pu is 0.6%. A possible application of the method would be in the control of feed solution in a chemical plant processing natural U fuel elements as, for example, the Windscale primary separation plant. (auth)

19316 GRAVIMETRIC DETERMINATION OF THORIUM USING SOME CARBOXYLIC ACIDS. Ch. Bheemasankara Rao, P. Umapathi, V. Venkateswarlu (Andhra Univ., Waltair, India). Anal. Chim. Acta, 24: 391(Apr. 1961). (In English)

Some synthetic carboxylic acids were investigated. Determinations were completed by ignition to thoria. O-bromobenzoic acid was useful for separating Th from rare earths. (P.C.H.)

19317 THE DETERMINATION OF C^{14} AND P^{32} IN ANIMAL TISSUE AND BLOOD FRACTIONS BY THE LIQUID-SCINTILLATION METHOD. H. G. Badman (Queen's Univ., Belfast) and W. O. Brown. Analyst, 86: 342-7(May 1961).

A liquid-scintillation method for determining C^{14} and P^{32} in tissues, blood sera and their fractions is described. The influence of the volumes of scintillator, sample and Hyamine 10-X solution on the efficiency of counting water-soluble sources of P^{32} is studied. Investigation of the use of p-dioxane to achieve miscibility between scintillator and lipid extracts from fresh tissues and blood sera has shown that this substance has no effect on the efficiency of counting. The optimum volumes of scintillator, p-dioxane and Hyamine 10-X solution for maximum efficiency are summarized. Efficiencies of counting for the various types of extract from blood sera and oviduct protein were reproducible, so that the absolute activities in the fractions could be calculated; the sum of these activities was equal to the activity in the whole-blood sera and protein determined independently. (auth)

19318 THE SPECTROGRAPHIC DETERMINATION OF URANIUM 235. PART III. USE OF A MULTIPLE HOLLOW CATHODE SOURCE ASSEMBLY AND A 22 FOOT DIRECT READING EAGLE SPECTROGRAPH. Ted Lee and S. A. MacIntyre (Union Carbide Nuclear Co., Oak Ridge, Tenn.). Appl. Spectroscopy, 15: No. 2, 34-9(1961).

Work done with a 22-ft Eagle mounted, direct-reading spectrograph using 5 in. of a 15000 lines/in. concave grating in the second order is described. Samples were excited in a multiple source assembly consisting of 4 hollow cathode source lamps and an automatically positioned selector mirror. This arrangement allowed close comparison of unknown and standard, minimized the effect of exit slit misalignment, and an allowed large number of routine samples to be handled economical. A complete analysis in duplicate, including comparison standards, was made in less than 20 min. Measurements on 4 standards having U^{235} concentrations in the range of 10 to 51% showed average external and internal precisions of ±0.23 and ±0.048% U^{235} for a single cathode determination.

Analyses of 32 unknown samples containing 10 to 85% U^{235} determined independently on the optical spectrograph and the mass spectrometer, showed good agreement. Comparative measurements on 65 unknown samples in the range of 30 to 40% U^{235} showed an agreement of ±0.17% U^{235} with no significant bias. All precisions were expressed at the 95% confidence level. The factor limiting the precision—a weak line interfering with the U^{235} measurement, and the effect of U^{234} and U^{236} on the analysis are discussed. (auth)

19319 ROTATIONAL ANALYSIS OF THE BLUE-GREEN AND ORANGE SYSTEMS OF YTTRIUM OXIDE. U. Uhler and L. Åkerlind (Univ. of Stockholm). Arkiv Fysik, 19: 1-16 (1961). (In English)

The blue-green and the orange systems of YO were photographed at high dispersion. Rotational analysis of the 0,0 bands of both systems was carried out. The analysis conforms with the earlier assumption that the systems represent a $^2\Sigma - ^2\Sigma$ and a $^2\Pi - ^2\Sigma$ transition respectively. The lower states of the systems are identical ($X^2\Sigma$). The upper state of the blue-green system ($B^2\Sigma$) shows a very large spin-splitting. The upper state of the orange system $A^2\Pi$ belongs to Hund's case a. Constants are included. (auth)

19320 RADIOACTIVATION ANALYSIS. Derek Gibbons (Wantage Research Lab., Berks, Eng.). Atom, No. 54, 12-13; 15(Apr. 1961).

A technique is given for measurement of minor impurities in samples, by measurement of radioactivity induced in the samples. The radioactivation may be accomplished using either accelerated charged particles or neutrons. Procedures are given for isolating the activity of the impurity from that of extraneous sources. Limitations, advantages, and other aspects of the technique are noted. The sensitivity varies between 10^{-7} and 10^{-10} g, depending on the impurity. (T.F.H.)

19321 THE APPLICATION OF THE VARIABLE INTERNAL STANDARD METHOD TO THE QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM OXIDES. Tokunosuke Nakajima, Hiroshi Kawaguchi, Kyoichiro Takashima, and Yaeko Uruno (Japan Atomic Energy Research Inst., Tokyo). Bunseki Kagaku, 10: 221-6(Mar. 1961). (In Japanese)

The variable internal standard method is applied to the spectrographic determination of impurities (Ni, Cr, Mn, Mg, Si, and Al) in uranium oxides. Iron contained inherently in the sample as an impurity is used as the internal standard element, the content of which has been determined photometrically with 8-quinolinol. The reproducibilities of the determinations of the elements above are improved considerably. The carrier-distillation method is adopted as the excitation procedure. Correction curves and working curves for the respective elements are prepared by the statistical method proposed by Calder. Different combinations of analytical line and reference line give widely different reproducibilities of intensity ratios, and the suitable analytical line pairs are determined experimentally. Better than 10% reproducibilities are obtained for 5 to 100 ppm each of the elements above. (auth)

19322 QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF METALLIC IMPURITIES IN ZIRCONIUM. Nakaaki Oda and Mitsuru Idohara (Nippon Soda Co., Ltd., Takaoka, Japan). Bunseki Kagaku, 10: 246-50(Mar. 1961). (In Japanese)

Spectrographic determination of Hf and other metals as impurities in metallic Zr and Zr compounds was investigated by the use of an ordinary d-c arc and intermittent a-c arc, and a medium quartz spectrograph. A method for practical applications was established, the outline of the procedure being as follows: (a) Impurities other than Hf (Al, Cr, Mg, Mn, Pb, and Ti) are determined by the d-c arc method after addition of Co as an internal standard to the sample and converting them into oxides. The average coefficient of variation of analysis is about 9%. (b) Hf is determined by the d-c arc method or by the intermittent a-c arc method after converting the sample to oxide. The lower limit of estimation of Hf by the former method is 100 ppm and that by the latter is 10 ppm, each coefficient of vibration being 10%. The method described in (b) can be applied simultaneously for determination of other impurity elements. (auth)

19323 A RADIATION-KINETIC METHOD OF DETERMINING VERY SMALL AMOUNTS OF POLONIUM. V. I. Kuznetsov and E. S. Ul'yanova. Doklady Akad. Nauk S.S.S.R., 137: 869-72(Apr. 1, 1961). (In Russian)

The tendency of periodate ion to give sharp colored precipitates can be used for the photometric determination of very small amounts of quadrivalent polonium (Po^{210}). The polonium is carried down initially on butyl rhodamine iodide and causes a local radiolysis of iodide to periodate, which in turn precipitates with more butyl rhodamine and results in a build-up of the colorimetric reaction. Elements such as Te (IV), Cd, Hg, Bi and Sb interfere. A concentration of 5×10^{-8} γ/ml of Po^{210} can be detected in a solution containing 9.6×10^{-3} M KI, 5.5×10^{-5} M butyl rhodamine chloride and 4.0 N H_2SO_4. The color developed three minutes after mixing the ingredients was compared with standard solutions of a 0.001% aqueous solution of safranine and a 0.0014% aqueous solution of methylene blue. Po^{210} can be determined in the presence of Pu^{239} with the use of calibration curves on known amounts of Pu^{239}. This reaction can also be used with other alpha emitters which form ions that will coprecipitate with organic precipitants. (TTT)

19324 THE USE OF NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF THE TUNGSTEN CONTENT IN MINERALS AND BENEFICIATED CONCENTRATES. I. N. Plaksin, I. F. Slepchenko, and L. P. Starchik (Mining Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 880-1(Apr. 1, 1961). (In Russian)

The tungsten content in scheelite concentrates was determined by irradiating a sample 1.5 hours with neutrons from a polonium-beryllium source containing 8 curies of polonium. The sample was held for 20 minutes to allow short half-life activities of Al and Si to die out, and the induced 1.33 mev beta activity of W^{187} ($T_{1/2}$ = 24.1 hrs) was counted on an end-window counter. Other elements accompanying the tungsten in the scheelite concentrate have a low capture cross-section (Si, Sn, Ca, Fe, S, Mg, Ni), or are present in such low concentrations that they do not interfere with the determination of tungsten (elements such as Cu, As, Mn, Na and P). A plot of tungsten content versus the induced beta activity in counts per minute gave a straight line for samples of scheelite mixed with fluorite. This method can be used to determine tungsten in steels and cermets. (TTT)

19325 ON THE ACTIVATION ANALYSIS OF OXYGEN WITH HELP OF THE REACTION $O^{16}(t,n)F^{18}$. H. J. Born and P. Wilkniss (Technische Hochschule, Munich). Intern. J. Appl. Radiation and Isotopes, 10: 133-6(Apr. 1961). (In German)

The reaction $O^{16}(t,n)F^{18}$ was used for the determination of oxygen in metal powders. Preliminary results for lithium and thorium are reported. The neutron source was a swimming pool type reactor. The irradiation was carried out in the water near the core. After irradiation the metal was dissolved in methanol and water. Glass wool, H_2SO_4, and

NaF were added. The F^{18} was distilled off as H_2SiF_6 and then precipitated as PbClF. The activity was counted using a NaCl(Tl) crystal detector. The fluoride content was also determined by volumetric analysis. (M.C.G.)

19326 RADIOCHEMICAL SEPARATION OF LANTHANIDES IN FISSION PRODUCTS. Frank Clanet (Commissariat à l'Énergie Atomique [Paris]). J. Chromatog., 5: 356-62(Apr. 1961). (In French)

The method described permits the chromatographic separation (yields 80 to 85%) of fission products of the lanthanide group for determination by physical methods. An apparatus was used with which the conditions of elution can be altered at will. Two examples of such a separation are given to illustrate the operation of the apparatus. (auth)

19327 SEPARATION OF RADIOELEMENTS BY CHROMATOGRAPHY WITH PAPER IMPREGNATED WITH ION EXCHANGE MINERAL. J. P. Adloff (Centre de Recherches Nucléaires, Strasbourg-Cronenbourg, France). J. Chromatog., 5: 366-7(Apr. 1961). (In French)

Separations were conducted as rapidly as possible because of the short lives of certain radioelements. The paper, impregnated with Zr oxychloride, was treated with ammonia or sodium tungstate. After washing and drying, the papers were cut in strips 2 × 12 cm and placed in a water vapor atm at 60°. The strips were counted by standard G-M methods. Scavenging was done at regular intervals. The separation of Tl^{+} to Tl^{3+} is particularly interesting and is utilized for the quantitative determination of the two valence states. (P.C.H.)

19328 POLAROGRAPHY OF BISMUTH IN MOLTEN BISMUTH(III) CHLORIDE. L. E. Topol and R. A. Osteryoung (Atomics International, Canoga Park, Calif.). J. Electrochem. Soc., 108: 573-6(June 1961).

A polarographic study is carried out between 240° and 350° on solutions of bismuth in molten bismuth(III) chloride. The bismuth was introduced coulometrically by reduction of $BiCl_3$ at a graphite electrode. Polarograms yielded an anodic wave indicating the oxidation of a soluble entity; anodic limiting currents were directly proportional to the concentration of bismuth up to about 0.2 mole % Bi in $BiCl_3$. From the polarographic behavior it was concluded that the electrode reaction is probably reversible, and although a log plot analysis was not conclusive (n values of 1.5 to 1.8 were obtained), a subhalide BiCl is considered a probable entity. An activation energy for the current limiting process was determined as 5.8 ± 1.1 kcal. (auth)

19329 REMOTE ANALYSIS OF SURFACES BY NEUTRON–GAMMA-RAY INELASTIC SCATTERING TECHNIQUE. C. D. Schrader and R. J. Stinner (Univ. of California, Livermore). J. Geophys. Research, 66: 1951-6(June 1961). (UCRL-6327)

Neutron γ-production techniques were applied to the remote chemical analysis of unknown materials. The spectra of γ rays produced by 14-Mev neutrons in a large sandpile containing various known percentages of O, Mg, Al, Si, and Fe were measured. It was found that a 5% abundance of any of these elements can be quantitatively determined to a precision of better than 10%. The method, using fast gating and timing circuits to select only the γ rays originating unambiguously from the neutron inelastic scattering process, appears so promising that a miniature, pulsed accelerator is now being tested and packaged. Applications to the analysis of the lunar surface, planetary atmospheres, and the earth's crust and mantle are discussed. (auth)

19330 DIMETHYLAMINOHYDROXYPHENOXAZONE CARBOXYLIC ACID AS AN INDICATOR IN COMPLEXOMETRIC DETERMINATION OF THORIUM. Satendra Prashad Sangal and Arun K. Dey (Univ. of Allahabad, India). J. Indian Chem. Soc., 38: 75-6(Feb. 1961).

Use of dimethylaminohydroxyphenoxazone carboxylic acid (gallocyanine) as an indicator in the complexometric determination of thorium with EDTA is described. The use of 0.03 cc of indicator solution (0.02% in 5% Na_2CO_3 and neutralized to pH 7.0) in each titration is recommended. Sharp end points are observed up to a dilution of 0.0033M thorium chloride. The titrations are possible in the temperature range of 0° to 100°, but pH must be adjusted between 2.0 and 2.7. Several added foreign ions are found to interfere, but there is no interference from lithium, sodium, potassium, silver, calcium, strontium, barium, zinc, mercury, lead, and manganese ions. (auth)

19331 MOISTURE AND DENSITY MEASUREMENTS IN SOILS AND OTHER MATERIALS BY THE NUCLEAR METHOD. Jack R. Templeman (Nuclear-Chicago Corp., Des Plaines, Ill.). Nondestructive Testing, 19: 188-93 (May-June 1961).

The nuclear moisture test method consists of exposing a material containing moisture to a source of hign energy neutrons. The neutrons will collide with the hydrogen nuclei and lose kinetic energy with each collision. After many collisions the resultant slow neutron may be detected with a properly located slow neutron detector. There is a well defined linear relationship between the number of slow neutrons and the moisture content of the material. A similar relationship is found between the wet density material and the number of scattered or transmitted gamma rays. These techniques are applied to moisture and density measurements in soils and have resulted in the development of a rapid routine method which is having an important impact in the soil science, civil engineering, industrial and construction fields. It is now possible to make continuous measurements on fluids, slurries and conveyored solids with industrial process control equipment that utilize the same nuclear principles. Water content and density can be controlled on a wide variety of industrial materials allowing better uniformity to be achieved in an economical manner. (auth)

19332 RADIOMETRIC CHEMISTRY FOR AUTOMATIC PROCESS CONTROL. Benjamin F. Scott and William J. Driscoll (Nuclear-Chicago Corp., Des Plaines, Ill.). Nucleonics, 19: No. 6, 49-52(June 1961).

Radiometric analysis methods are reviewed. Four techniques are described: isotope dilution, extent-of-reaction analysis, end-of-reaction analysis, and analysis evaluation. The accuracy of radiometry is outlined. An automatic radiometric boiler-water analyzer is described, which measures PO_4^{-3} concentrations from 0 to 50 ppm. Counting techniques using centrifuges, planchets, and other methods of phase separation are examined. (T.F.H.)

19333 X-RAY SPECTROMETRY WITH RADIOACTIVE SOURCES. John F. Cameron and John R. Rhodes (Atomic Energy Research Establishment, Berks., Eng.). Nucleonics, 19: No. 6, 53-7(June 1961).

An x-ray spectrometric method is described in which x rays at ~100 kev from a radioactive source strike a sample; the characteristic x rays of the sample are "backscattered" into a proportional detector. Sources of Am^{241}, Pm^{147} dispersed in Al, and H^3 dispersed in Ti or Zr are compared. The uses of the method in chemical analysis of alloys, compounds, and impurity elements are reviewed. The thicknesses of coatings may also be measured; examples are given of metals plated onto other metals. (T.F.H.)

19334 3-ACETYL-4-HYDROXYCOUMARIN AS A REAGENT FOR THE GRAVIMETRIC DETERMINATION OF ZIRCONIUM AND TITANIUM. A. N. Bhat and D. B. Jain (Univ. of Delhi). Proc. Indian Acad. Sci., Sec. A, 53: 147-50(Mar. 1961).

When an alcoholic solution of 3-acetyl-4-hydroxycoumarin is added to zirconyl salt solution, a pale yellow precipitate is obtained, which on ignition yields ZrO_2. Zirconium can in this way be conveniently determined between the pH 3.5 and 7.0, and under these conditions as little as 2.2 mg of ZrO_2 can be estimated. Ti is similarly precipitated from a solution of potassium titanyl oxalate with this reagent. The precipitate on ignition gives TiO_2. Ti can in this way be estimated between pH 7.0 and 9.0. Under these conditions, quantities as low as 7.1 mg of TiO_2 can be estimated accurately. (auth)

19335 DETERMINATION OF RADIOACTIVE Sr IN OPEN WATER RESERVOIRS. V. L. Zolotavin and L. K. Ponomareva. Radiokhimiya, 2: 104-6(1960). (In Russian)

A new method is suggested for determining small quantities of Sr^{90} and Sr^{89} in reservoirs by using a sodium salt of rhodizonic acid. The maximum error is ±10%. The method is capable of determining Sr^{90} up to 5×10^{-11} c/l; the presence of Cs^{137}, Ru^{106}, Ce^{144}, and Zr^{95} does not interfere. (R.V.J.)

19336 DETERMINATION OF RADIOACTIVE ADMIXTURES IN Ge^{71} AND PRODUCTION OF RADIOCHEMICALLY PURE Ge^{71}. M. M. Golutvina and E. A. Tikhomirova. Radiokhimiya, 2: 112-19(1960). (In Russian)

The contents of Se^{75}, Sb^{124}, Tm^{170}, and Cs^{134} in Ge^{71} preparations were determined, and it was found that the quantitative composition of the admixtures varies. A simple rapid method was developed for extracting radiochemically pure Ge^{71}. (R.V.J.)

19337 GRAVIMETRIC DETERMINATION OF ZIRCONIUM AFTER ITS PRECIPITATION WITH CYCLOHEXANOL-1-CARBOXYLIC ACID. I. P. Alimarin and Han-hsi Shen (Moscow State Univ.). Zhur. Anal. Khim., 16: 162-5(Mar.-Apr. 1961). (In Russian)

A new gravimetric method was developed for the determination of zirconium using cyclohexanol-1-carboxylic acid as a precipitator. The precipitates formed are of various composition. They are ignited to ZrO_2. The method permits the determination of zirconium in the presence of aluminum, iron(III), beryllium, tin(IV), titanium, thorium, uranium(VI), and rare earths. Zirconium was determined in an alloy and a mineral and satisfactory results were obtained. (auth)

19338 THIOMALIC ACID AS A REAGENT FOR THE PHOTOMETRIC DETERMINATION OF MOLYBDENUM. A. I. Busev and Chang Fang (Moscow State Univ.). Zhur. Anal. Khim., 16: 171-9(Mar.-Apr. 1961). (In Russian)

The reaction of Mo^{6+} and Mo^{5+} with thiomalic acid under various conditions is studied. It is shown that the reaction is similar to that with thioglycollic acid. Two methods are developed for the photometric determination of small amounts of molybdenum (in a 0.5N HCl medium at pH 3.6). The selectivity of the first method is much higher, but the sensitivity is lower. The methods developed can be used for determining molybdenum in high-alloy steel. (auth)

19339 2,7-BIS-(4-CHLORO-2-PHOSPHONBENZENE-AZO)-1,8-DIHYDROXYNAPHTHALENE-3,6-DISULPHONIC ACID (CHLOROPHOSPHONAZO)III. A NEW REAGENT FOR THE PHOTOMETRIC DETERMINATION OF URANIUM. A. A. Nemodruk, Yu. P. Novikov, A. M. Lukin, and I. D. Kalinina (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 16: 180-4(Mar.-Apr. 1961). (In Russian)

A new highly sensitive reagent for the photometric determination of U^{6+}—chlorophosphonazo III is suggested. The molar absorptivity for solutions of uranium-reagent compound at 670 mμ is 78600. Due to the high stability of the colored compound formed, it is possible to determine U^{6+} in the presence of large quantities of fluorides, phosphates, and oxalates. Sulfates, tartrates, and ethylenediaminetetraacetic acid do not interfere in any quantities. A method was devised for the direct photometric determination of uranium in zirconium alloys using Na_2SiF_6 to eliminate the interference of zirconium. The synthesis of chlorophosphonazo III is described. (auth)

19340 INFLUENCE OF VANADIUM ON THE DETERMINATION OF URANIUM BY MEANS OF HYDROSULPHITE-PHOSPHATE TITRIMETRIC AND PHOTOMETRIC METHODS. V. M. Brodskaya, G. A. Lanskoi, and V. G. Sochevanov. Zhur. Anal. Khim., 16: 185-90(Mar.-Apr. 1961). (In Russian)

It is shown that when uranium is determined by means of the hydrosulfite-phosphate method in the presence of vanadium, the results are high due to adsorption of lower compounds of vanadium with uranium(IV) phosphate. The interference of vanadium is suggested to be eliminated by washing phosphate precipitates with an iodine solution. (auth)

19341 POLAROGRAPHIC AND AMPEROMETRIC DETERMINATION OF RUTHENIUM. N. K. Pshenitsyn and N. A. Ezerskaya (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, Moscow). Zhur. Anal Khim., 16: 196-200(Mar.-Apr. 1961). (In Russian)

A method for the polarographic determination of ruthenium by the reduction wave of $[RuCl_6]^{2-}$ on a platinum microelectrode was worked out. The method permits 1 to 200 γ/ml of ruthenium to be determined in the presence of platinum, palladium, rhodium, osmium, and some other non-precious metals. A method for the amperometric titration of Na_2RuCl_6 with a hydroquinone solution, using a rotating platinum electrode, was also developed. The method can be used for the same quantities of ruthenium as the above polarographic method, but the procedure is more simple. (auth)

19342 ON THE WATER DETERMINATION IN COMPOUNDS BY MEANS OF THE HYDRIDE METHOD. G. M. Toptygina (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 16: 201-4(Mar.-Apr. 1961). (In Russian)

The possibilities of the hydride method with pyridine are shown to be rather limited. The aluminum, iron, lanthanum, and cerium compounds used as examples of the correct determination of water in Elitsur's paper must give higher water contents. Lanthanum, cerium, and other rare earth hydroxides chip off some water at temperatures below 150°. (auth)

19343 ON THE ANALYSIS OF TRANSITIONAL ELEMENT AND RARE EARTH BORIDES. L. N. Kugai and T. N. Nazarchuk (Inst. of Metallo-Ceramics and Special Alloys, Academy of Sciences, Kiev). Zhur. Anal. Khim., 16: 205-8(Mar.-Apr. 1961). (In Russian)

A method for determining free boron in zirconium boride, based on the different oxidability of free boron and boron bounded with a mixture of perhydrol and nitric acid, is described. It is shown that it is impossible to use acid solutions of cerium sulfate and potassium iodate for the determination of free boron in borides of Ti, Zr, Cr, W, and rare earths owing to rather considerable solubility of

borides in these mixtures. A simple method for the analysis of rare earth hexaborides is suggested. (auth)

19344 QUANTITATIVE DETERMINATION OF TRACES OF BARIUM, NICKEL, COPPER, ANTIMONY, MOLYBDENUM, MANGANESE, CADMIUM, TIN, GOLD, ARSENIC IN BERYLLIUM METAL BY THE RADIOACTIVATION METHOD. V. R. Negina and V. N. Zamyatnina. Zhur. Anal. Khim., 16: 209-12(Mar.-Apr. 1961). (In Russian)

Methods are developed for separating beryllium, barium, nickel, copper, antimony, molybdenum, manganese, cadmium, gold, tin, and arsenic. The possibility is established of extracting As, Au, Sn^{4+}, Ni, Cu, Sb^{3+}, and Mo as diethyldithiocarbamate complexes into chloroform from 10 to 12 N HCl. It is established that the preliminary reduction of antimony with hydrazine hydrochloride is necessary for the complete extraction of the antimony diethyldithiocarbamate complex into chloroform. A radioactivation method is developed for the determination of Ba, Ni, Cu, Sb, Mo, Mn, Cd, Sn, Au, and As impurities in beryllium metal. (auth)

19345 RADIOACTIVATION DETERMINATION OF IMPURITIES IN THALLIUM OF HIGH PURITY. I. P. Alimarin, Yu. V. Yakovlev, M. N. Shchulepnikov, D. A. Vlasov, G. M. Chernov, and Yu. A. Surkov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 16: 213-26 (Mar.-Apr. 1961). (In Russian)

An analysis of four thallium samples was carried out and a method was developed for determining Mn, Cu, Zn, As, and Sb impurities. The sensitivity of the determinations is within 10^{-5} and 4×10^{-8}%. (auth)

19346 DETERMINATION OF IMPURITIES IN THORIUM AND ITS COMPOUNDS BY THE CHEMICO-SPECTROGRAPHIC METHOD. A. G. Karabash, Sh. I. Peizulaev, V. P. Usacheva, G. G. Morozova, V. M. Meshkova, and V. L. Lobanova. Zhur. Anal. Khim., 16: 217-22(Mar.-Apr. 1961). (In Russian)

Two modifications of the chemico-spectrographic method were worked out for the determination of impurities in thorium and its compounds. According to the first, the concentration of admixtures is carried out by separating thorium as oxalate in a weak nitric acid medium; the enrichment coefficient is 20 to 30. In the second, the concentration of admixtures is carried out by separating thorium from a weak nitric acid solution as peroxide with the enrichment coefficient equal to 2.5 to 5. In both cases the powdery concentrate with beryllium oxide is analysed spectrographically by exciting spectra in a d-c arc and photographing them on a quartz spectrograph with a medium dispersion. By the first method the following 18 elements are determined on a single spectrogram: Mg, Ca, Ba, Al, Ti, V, Cr, Mo, Mn, Fe, Co, Ni, Cu, Ag, Zn, Cd, Sn, Sb; by the second method—15 elements: Mg, Ca, Ba, Al, Cr, Mo, Mn, Fe, Co, Ni, Cu, Ag, Zn, Cd, and Pb. Due to the concentration of impurities the sensitivity of their determination increases correspondingly (up to 10^{-4} to 10^{-5}%). (auth)

19347 SPECTROCHEMICAL DETERMINATION OF SMALL AMOUNTS OF ALUMINIUM AND SILICON IN NIOBIUM PENTOXIDE. T. M. Moroshkina and G. F. Malinin (Zhdanov Leningrad State Univ.). Zhur. Anal. Khim., 16: 245-7(Mar.-Apr. 1961). (In Russian)

A spectrographic method is developed for the direct determination of small amounts of aluminum (down to 0.001%) and silicon (down to 0.005%) in difficultly volatile niobium pentoxide using the fractional distillation of the samples. The experimental error is within ±12%. (auth)

19348 PHOTOMETRIC DETERMINATION OF ZIRCONIUM WITH XYLENOL ORANGE. V. F. Lukyanov and E. M. Knyazeva. Zhur. Anal. Khim., 16: 248-9(Mar.-Apr. 1961). (In Russian)

A photometric method is proposed for the determination of zirconium by its reaction with xylenol orange. The method is satisfactorily sensitive (0.1 γ/ml) and selective. The great advantage of the reaction is that the complex forms instantaneously and is stable for several days. The method was used for the determination of zirconium in ores with good results. (auth)

19349 DETERMINATION OF SMALL AMOUNTS OF NIOBIUM IN ORES CONTAINING TITANIUM, TUNGSTEN, MOLYBDENUM AND CHROMIUM. V. M. Dorosh (Irkutsk Scientific-Research Inst. of Rare Metals, USSR). Zhur. Anal. Khim., 16: 250-2(Mar.-Apr. 1961). (In Russian)

Small amounts of niobium are separated by coprecipitation with manganese dioxide when ores containing titanium, tungsten, molybdenum, and chromium are analyzed. Niobium is then determined photometrically by the thiocyanate method. (auth)

19350 ON THE DETERMINATION OF PALLADIUM AND NICKEL, AND PALLADIUM AND COPPER WHEN PRESENT TOGETHER. A. S. Pesis (Perm State Medical Inst., USSR). Zhur. Anal. Khim., 16: 253-4(Mar.-Apr. 1961). (In Russian)

A method is suggested for the determination of palladium and nickel, and palladium and copper from a single sample. Palladium is precipitated with β-hydroxynaphthaldehyde at pH 2.5 to 3, nickel and copper are precipitated at pH 7.2 to 7.5. (auth)

19351 ON THE USE OF NAPHTHOL YELLOW INSTEAD OF URANYL NITRATE IN THE STANDARD METHOD FOR THE DETERMINATION OF OXIDABILITY OF COMMERCIAL ETHYL ALCOHOL. I. S. Mustafin and N. K. Nemkova (Saratov State Univ., USSR). Zhur. Anal. Khim., 16: 255(Mar.-Apr. 1961). (In Russian)

The possibility is shown of using a naphthol yellow dye instead of uranyl nitrate when preparing a standard solution for the determination of oxidability of alcohol. (auth)

19352 ADVANCES IN X-RAY ANALYSIS. VOLUME 4. William M. Mueller, ed. Proceedings of the Ninth Annual Conference on Application of X-Ray Analysis, Held August 10-12, 1960. New York, Plenum Press, 1961. 574p. $15.00.

Contains 38 papers on new developments in x-ray analytical techniques and instrumentation. Separate abstracts were prepared for 9 papers; one paper was previously abstracted in NSA. The papers not abstracted separately contain information on diffraction analysis, computer techniques, and techniques for studying various alloys and systems, amorphous materials, amphibolite rocks, cements, and features of various x-ray devices. (P.C.H.)

19353 PULSE-HEIGHT SELECTION IN X-RAY FLUORESCENCE. Kurt F. J. Heinrich (E. I. du Pont de Nemours and Co., Wilmington, Del.). p.370-81 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

Pulse-height analysis is a valuable tool in x-ray fluorescence analysis for qualitative and quantitative purposes. The elimination of higher order interferences permits determinations that would otherwise be very difficult or impossible. The systematic application of pulse-height analysis in qualitative work greatly simplifies the interpretation of complex spectra. In certain cases one can apply nondispersive analysis, relying on the pulse-height

analyzer alone for separating energy levels of x-ray photons. Technique and limitations of pulse-height analysis are discussed. (auth)

19354 X-RAY SPECTROMETRIC DETERMINATION OF COPPER, TIN, AND URANIUM IN BRONZE HEAT-TREATING MATERIAL. G. R. Blank and H. A. Heller (National Lead Co. of Ohio, Cincinnati). p.457-73 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

The method is based on the irradiation of an acid solution of the sample, to which In and Zn have been added as internal standards. Quantitative determinations of Cu and Sn (each in the 40 to 60% range) are calculated from the ratios of the CuK_α/ZnK_α and SnK_α/InK_α intensities. U concentration (in the 1 to 10% range) is calculated from the ratio of the UL_{α_1}/InK_α intensities. A correction for the interference of the second-order In $K_{\beta_{1,3}}$ doublet with the first-order UL_α peak is described. The over-all limits of error for single determinations at the 95% confidence level are ±0.58% Cu, ±0.56% Sn, and ±0.31% U. (auth))

19355 FLUORESCENCE ANALYSIS OF TRACE AMOUNTS OF HAFNIUM IN ZIRCONIUM USING A SILICON CRYSTAL. J. C. Parks, Jr., D. G. Plackmann, and G. H. Beyer (Univ. of Missouri, Columbia). p.488-94 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

The proper choice of an analyzing crystal sometimes makes it possible to suppress second-order reflections which interfere with x-ray fluorescence analysis. Some of the problems associated with the analysis of small amounts of Hf in Zr, using a Si crystal and a pulse-height analyzer. are discussed. (auth)

19356 NEW INSTRUMENTS FOR X-RAY ANALYSIS. Thomas C. Furnas, Jr. and Eugene W. White (Picker Research Center, Cleveland). p.521-37 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

New instruments for x-ray or neutron diffraction or for analyses by x-ray spectrographic methods are described. The diffractometer can be used with the diffraction plane either horizontal or vertical. The x-ray tube is conveniently supported by the diffractometer, allowing one to adjust the take-off angle from 0 to 10° without disturbing the precise alignment of the instrument. The 2θ angle bisecting mechanism functions throughout a 360° range and allows independent rotation (ω) of the specimen about the common axis. It is designed specifically for fully automatic remotely programed operation in addition to the usual manual modes. The constant-potential generator is rated up to 50 ma at 50 kvcp and up to 40 ma at 60 kvcp. A monitor-type switch selects combinations of kv and ma so that exact reproducibility is assured. The dual-function strip-chart recorder incorporates both linear and three-cycle logarithmic slide wires so that each uses the output from the same linear ratemeter. The Integrated Radiation Analyzer consists of a pulse-height analyzer, electronic timer, high-speed scaler, precision linear ratemeter, power supply, printer, and diffractometer control. (auth)

19357 DETERMINATION OF THE QUALITY OF LIQUID IN A CONTAINER BY MEANS OF NEUTRONS. K. Diebner. Belgian Patent 593,408. Priority date, July 30, 1959.

The method used is independent of the shape of the container. One or several fast neutron sources are positioned around the container. Slow neutron counters give a reading proportional to the quantity of the liquid which acts then as a moderator. A cadmium filter is placed between the neutron source and the container in order to stop all neutrons having an energy below 0.35 ev from interfering with the count due to the neutrons slowed down by the liquid. (EURATOM)

General Inorganic and Physical Chemistry

19358 (ANL-5889(Add.)) DEUTERIUM–HYDROGEN EXCHANGE IN BOEHMITE CORROSION PRODUCT FORMED ON PURE ALUMINUM IN BOILING WATER. Shiro Mori, J. E. Draley (Argonne National Lab., Ill.), and R. B. Bernstein (Michigan. Univ., Ann Arbor). Work completed Feb. 1959. Report written Dec. 1960. Contract W-31-109-eng-38. 5p.

Proton-deuteron exchange is rapid in boehmite corrosion product formed on pure aluminum in boiling water. In addition, deuterated boehmite films undergo rapid exchange with the humidity of the atmosphere. This explains the previously reported anomaly in the H-D exchange rate for the growing corrosion product on 1100 aluminum. (auth)

19359 (NP-10167) ACETYLENE: HIGH-PRESSURE SOLUBILITY AND THERMODYNAMIC PROPERTIES. George E. Owens, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Apr. 1961. 9p. (SB-61-14)

An annotated bibliography is presented consisting of 18 references on the solubility and thermodynamic properties of acetylene. Principal sources consulted, in addition to catalogs of LMSD'S Technical Information Center, were: Applied Science and Technology Index, 1948 to 1960; Chemical Abstracts, 1947 to 1960; Engineering Index, 1946 to 1960; Nuclear Science Abstracts, 1951 to 1960; and ASTIA, 1958 to 1960. (B.O.G.)

19360 (NP-10174) COMBUSTION OF ELEMENTAL BORON. Quarterly Summary Report for February through April 1960. (Experiment Inc., Richmond). May 1, 1960. 10p. (EXP-223; TM-1211)

Combustion experiments were continued on boron rods burning cigarette fashion at high temperatures. Rates of self-propagating combustion were determined at 0.04 atm. and 2300°K in pure oxygen. Combustion-rate data were obtained at 1 atm. in a mixture of 97% O_2 and 3% water vapor. Other burning experiments were carried out with electrically heated boron rods at 1000 to 2300°K in pure water vapor and submerged in H_2O at 1 atm. A relatively low reaction rate between massive boron and nitrogen was demonstrated. (auth)

19361 (NP-10209) MOLTEN CARBONATE ELECTROLYTES: PHYSICAL PROPERTIES, STRUCTURE, AND MECHANISM OF ELECTRICAL CONDUCTANCE. Technical Report No. 12. George J. Janz and Max R. Lorenz (Rensselaer Polytechnic Inst., Troy, N. Y.). Mar. 1961. Contract Nonr 591-(10). 32p.

Presented at a Fuel Cell Symposium, Electrochemical Society, National Meeting, Indianapolis, May 1961.

The present communication reports the results of an investigation of the properties of surface tension, density, and electrical conductance for molten Li_2CO_3, Na_2CO_3, and K_2CO_3 and some mixtures in the temperature range of 750° to 1000°C. The surface tensions are approximately twice the values for the corresponding chlorides; the densities and electrical conductance are quite comparable to those of the chlorides. The ionic nature of the molten carbonates is examined from the physico-chemical criteria based on these properties. The mechanism of electrical transport

is considered in the light of current theoretical concepts. Relative to $Na_2CO_3-K_2CO_3$ mixtures, the surface tensions and partial molal volumes indicate but little deviations from the predictions for thermodynamically ideal mixtures. (auth)

19362 (TID-12746) METAL-WATER REACTIONS. A Literature Survey. Erminia U. Kauer (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 17, 1961. 5p.

A bibliography is presented listing information on water reactions with uranium, zirconium, and their alloys. The references are selected from Nuclear Science Abstracts (Jan. 15, 1957 to Feb. 28, 1961). 69 references. (B.O.G.)

19363 (WADC-TR-57-126(Pt.V)) PHOSPHINOBORINE POLYMERS. Ross I. Wagner (American Potash and Chemical Corp., Whittier, Calif.), Anton B. Burg (University of Southern California, Los Angeles), and Darwin L. Mayfield (Long Beach State Coll., Long Beach, Calif.). Jan. 1961. Contract AF33(616)-6913. 246p.

Experiments were conducted to find means of improving the thermal stability of linear phosphinoborine (borophane) polymers, and to introduce a variety of boron substituents into the linear and cyclic polymers. An investigation of the boron-to-nitrogen bond system led to two series of polycyclic borazene polymers one directly bonded and the other bonded through oxygen. Screening experiments on thermally stable polymer systems based on phosphorus-to-nitrogen, phosphorus-to-oxygen-to-silicon, and carbon-to-oxygen-to-silicon bond systems were conducted. (auth)

19364 (AWRE/TRANS/16) SOME INVESTIGATIONS OF THE PRODUCTION OF MONODISPERSED SUBSTANCES. A. H. M. Andreasen. Translated by J. R. T. Lloyd from Kolloid-Z., 104: (2/3), 181-9(1943). 17p.

The possibilities of producing mono-dispersed substances by precipitation were investigated for the particle range 3 to 0.3 μ, chiefly with barium sulfate; the method comprised the pouring together of solutions of sulfate and barium salts with certain additives. In such circumstances it is possible to produce mono-dispersions as spherulites with a particle size of about 3 μ by the addition of an acid (hydrochloric acid) to the solutions before pouring them together. If a substance reducing solubility (alcohol) is added, the particle size is reduced. Attempts were also made to produce mono-dispersed substances by the means of pouring together and forming an homogeneous mixture before precipitation occurred on account of the slowness of the chemical reaction. Mono-dispersed cuprous oxide was produced by the addition of an excess of Fehling's solution to a solution of a kind of sugar reacting with it; further, mono-dispersed mercuric iodide and thallium iodide were produced by pouring together the appropriate iodide and a solution of sodium sulfite. Finally, a series of mono-dispersed products of barium sulfate was produced in the form of long spherulites in the particle size range 4 to 0.14 μ. Here solutions of barium chloride and hydrogen peroxide were added to solutions of sodium thiosulfate with the addition of varying quantities of normal sodium citrate. (auth)

19365 (CEA-tr-A-934) DIFFUSION Du ^{133}Xe, Du ^{222}Rn ET Du ^{131}I DANS L'OXYDE DE THORIUM. (Diffusion of Xe-133, Rn-222, and I-131 in Thorium Oxide). H. J. Matzke and R. Lindner. Translated into French by L. Bory from Z. Naturforsch., 15a: 647-8(1960). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 24615.

19366 (CEA-tr-R-1112) ETAT DES MICROQUANTITES DE RADIO-ÉLÉMENTS EN SOLUTIONS DILUÉES. VIII. ADSORPTION DU LANTHANE SUR LE VERRE DE QUARTZ ET LE PLEXIGLAS. (State of Microquantities of Radio-elements in Dilute Solution. VIII. Adsorption of Lanthanum on Quartz Glass and Plexiglas). I. E. Starik and F. L. Ginsburg (Guinsbourg). Translated into French from Radiokhimiya, 1: No. 2, 171-3(1959). 8p.

During a study of the adsorption of lanthanum in nitric solution on quartz glass and plexiglas, as a function of the pH of the solution, it was determined that the adsorption maximum for a concentration of 10^{-14} mole/l corresponds to pH values near 7. The adsorption of microquantities of lanthanum on plexiglas is noticeably higher than adsorption on glass. The adsorption maximum of lanthanum on quartz glass for concentrations of 10^{-7} mole/l is found in the pH region 7 to 8. (tr-auth)

19367 (CEA-tr-R-1224) DETERMINATION DE LA CHARGE DES IONS COMPLEXES, À NOYAUX MULTIPLES, DU RUTHENIUM, PAR LA MÉTHODE D'ÉCHANGE IONIQUE. (Determination of the Charge of Complex Ruthenium Ions with Multiple Centers by the Ion Exchange Method). A. A. Grinberg, A. M. Trofimov, and L. Stepanova. Translated into French from Radiokhimiya, 2: No. 1, 78-82(1960). 11p.

The possibility of applying the method of ion exchange in determining the value of the charge of complex ions with multiple centers is shown. It is established that the ions of the red nitrated complex of ruthenium $[Ru_2(NH_3)_8OH(NO_3)_6]$ possess a positive charge, practically equal to six. (tr-auth)

19368 (CEA-tr-R-1304) PREPARATION DE CIBLES EN DEUTERIUM ET ZIRCONIUM SUR SUPPORT DE CUIVRE. (Preparation of Targets of Deuterium and Zirconium on Copper Bases). A. G. Zimelev and R. N. Kuzmin. Translated into French from Pribory i Tekh. Ekspt., No. 3: 139-41(1960). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 23278.

19369 (NP-tr-604) SYNTHESIS OF C-14 LABELLED POTASSIUM OXALATE AND OXALIC ACID. M. Zielinski and H. Wincel. Translated by J. Adam (U.K.A.E.A. Atomic Energy Research Establishment) from Roczniki Chem., 32: 1189-90(1958). 3p.

Metallic potassium is heated in an evacuated reaction vessel with coarse gravel to 360°C prior to introducing $C^{14}O_2$ purified of water vapor, producing C^{14}-labeled $K_2C_2O_4$ plus a quantity of K_2CO_3. The labeled oxalic acid is obtained by isotopic exchange between the non-active acid and the active $K_2C_2O_4$. $H_2C_2O_4$ may be obtained at higher specific activities by treating the $K_2C_2^{14}O_4$ with an inorganic acid and extracting the C^{14}-labeled oxalic acid with ether. (B.O.G.)

19370 CATION EXCHANGE BEHAVIOUR OF STRONTIUM ON DOWEX 50W-X8. Santosh K. Majumdar and Anil K. De (Jadavpur Univ., Calcutta). Anal. Chim. Acta, 24: 356-9(Apr. 1961). (In English)

The cation exchange chromatography of strontium on Dowex 50W-X8 is described. Nitric acid, hydrochloric acid, ammonium chloride, sodium nitrate, ammonium acetate, and citric acid were examined as eluants. Strontium can be separated from important fission products such as Cs, Zn, Cd, Ag, and Zr and also from U^{6+}, Th, Bi, Fe^{3+}, Cu^{2+}, and Hg^{2+}. (auth)

19371 CATALYTIC ACTIVATION OF MOLECULAR HYDROGEN BY RUTHENIUM(III) CHLORIDE COMPLEXES J. F. Harrod, Stefania Ciccone, and J. Halpern (Univ. of British Columbia, Vancouver). Can J. Chem., 39: 1372-6 (June 1961).

Ruthenium(III) chloride, in aqueous HCl solution, was

ound to activate H_2 homogeneously and to catalyze the reduction by H_2 of Ru^{4+} and Fe^{3+}. The kinetics of these reactions were examined and, in each case, the rate law was ound to be $-d[H_2]/dt = k_1[H_2][Ru^{3+}]$ where $k_1 = 4.0 \times 10^{14}$ xp $[-23,800/RT]$ M^{-1} sec^{-1}. The mechanisms of these eactions are discussed and compared to those of other omogeneously catalyzed reactions of hydrogen. A special eature of the present system is the resistance of the atalytic species itself (i.e. Ru^{3+}) to reduction by H_2. (auth)

9372 THE PREPARATION OF ALKOXIDES AND TRITHYLSILANOLATES OF Ti, Zr, V, Nb, Ta, AND Sn FROM HE DIALKYLAMIDES. I. M. Thomas (Univ. of Western ntario, London, Ont.). Can. J. Chem., 39: 1386-8(June 961).

The dialkylamides of Ti, Zr, V, Nb, Ta, and Sn are very eactive to reagents containing replaceable hydrogen atoms. hey are sensitive to moisture and react smoothly and ompletely with alcohols and triethylsilanol at room temerature in benzene to give alkoxides and triethylsilanolates, iberating dialkylamine. Nb^{4+} tetra-dialkylamides react ith alcohols and triethylsilanol to give pentavalent derivatives. The comparative stability of vanadium in the tetraalent state enabled substantially pure tetra derivatives to e prepared from V^{4+} tetra-dialkylamides. (P.C.H.)

9373 PERFORMANCE OF ANION RESINS IN AGITATED BEDS. W. E. Prout and L. P. Fernandez (E. I. u Pont de Nemours and Co., Aiken, S. C.). Ind. Eng. hem., 53: 449-52(June 1961).

The chemical performance of a miniature agitated bed f anion resin is studied, and a method for calculating the erformance from nonequilibrium absorption data is deeloped. Plutonium(IV) and thorium(IV) in concentrated itrate solutions were used to measure the performance of he agitated bed. Comparison of the performance of the niniature agitated bed with a large unit showed that data btained with the miniature unit can be scaled up without ifficulty. Calculated performance of both the large-scale nd miniature-scale agitated beds was in excellent agreenent with measured performance. (auth)

19374 SPECTROPHOTOMETRIC STUDIES IN THE COMPOSITION AND STABILITY OF THORIUM p-NITROBENZENEAZOCHROMOTROPIC ACID CHELATE. Samir K. Banerji (Univ. of Allahabad, India) and Arun K. Dey. J. Indian Chem. Soc., 38: 139-46(Mar. 1961).

p-Nitrobenzeneazochromotropic acid (sodium salt) was found to form a pink chelate with thorium salts. The chelate has the composition $ThKe_2$, λ_{max} lies at 550 mμ, which is stable between pH 3.2 and 7.2. The values of log K and $\Delta F°$ are respectively 10.08 ± 0.15 and −13.92 ± 0.20 kcals at 25°. (auth)

19375 HIGH TEMPERATURE ALLOTROPY AND THERMAL EXPANSION OF THE RARE-EARTH METALS. F. H. Spedding, J. J. Hanak, and A. H. Daane (Ames Lab., Ames, Iowa). J. Less-Common Metals, 3: 110-24(Apr. 1961). (In English)

By means of high temperature x-ray techniques the crystal structure of La, Ce, Pr, Nd, Yb, and possibly Gd was found to be body-centered cubic at temperatures near their respective melting points. For Yb a hexagonal close-packed structure was also observed and shown to be stabilized by atmospheric impurities. Evidence for possible high temperature crystalline transformations in Gd, Tb, Dy, Ho, and Lu was obtained by means of electrical resistance measurements; Er gave no such evidence. X-ray data were used to derive empirical equations describing thermal expansion coefficients of Sc, Y, and the rare-earth metals. Eu exhibits a rapidly decreasing coefficient of expansion with increasing temperature, which may be a consequence of a gradual promotion of one of the 4f electrons into the conduction band. The hexagonal rare-earth metals were found to have nearly the same axial ratio at their respective transformation temperatures. (auth)

19376 THE AMMONOLYSIS OF SOME HEXACHLOROZIRCONATES. J. E. Drake and G. W. A. Fowles (The University, Southampton, Eng.). J. Less-Common Metals, 3: 149-54(Apr. 1961). (In English)

Several hexachlorozirconates (M_2ZrCl_6, M = NH_4, Rb, and Cs) were prepared and allowed to react with liquid NH_3. The ammonolysis resembles that of $ZrCl_4$ in that $ZrCl_3(NH_2)\cdot xNH_3$ is formed. The enhanced solubility of the product when made from diammonium hexachlorozirconate is considered to result from complex formation. The tensimetric results suggest the initial formation of complex salts $M_2[ZrCl_5(NH_2)]$. (auth)

19377 AN EXPERIMENTAL STUDY CONCERNING THE PRESSURIZATION AND STRATIFICATION OF LIQUID HYDROGEN. A. F. Schmidt, J. R. Purcell, W. A. Wilson, and R. V. Smith. J. Research Natl. Bur. Standards, 65C: 81-7(Apr.-June 1961).

A 625 gal powder-insulated Dewar was built and appropriately instrumented to provide information concerning pressurization gas consumption, ullage pressure, liquid level (ullage volume, indirectly), horizontal and vertical temperature surveys throughout the test fluid, and lapsed time. Pressurization levels of 25, 75, 125, and 180 psig were examined individually. Two techniques—one based on the case of one-dimensional heat flow in a semi-infinite solid and the other founded on an electrical network analog of the thermal system—are given for making reasonable predictions concerning liquid-phase hydrogen temperature distribution is well-insulated, rapidly-pressurized storage vessels. A thermal analysis is presented which indicates the mechanics of heat transmission and adsorption in the fluid. (auth)

19378 AN EXPERIMENTAL EQUATION OF STATE FOR SODIUM. R. I. Beecroft and C. A. Sewnson (Ames Lab., Ames, Iowa). Phys. and Chem. Solids, 18: 329-344 (Mar. 1961).

An equation was obtained for pressures to 20000 atm and from 20°K to the mp. Various experimental details are given of an apparatus with which it is possible to obtain pressure-volume data which are reliable to ±0.002 in $\Delta V/V_0$ over this range of temperature and pressure. The equation of state can be represented to within the above accuracy by an expression which is derived from the assumption that the isothermal compressibility is linear with volume and has no explicit temperature dependence. A discussion is given of the effect of these assumptions on the validity of calculations of the variation with volume of the temperature dependent contribution to the thermodynamic functions. Grueneisen constants as obtained from various definitions are calculated as functions of temperature and volume, and the validity of the Mie-Grueneisen equation of state as it applies to Na appears open to question below room temperature. Recent high pressure ultrasonic experiments on Na are interpreted as being in agreement with this conclusion. (auth)

19379 CLOSED-SHELL ION-ION INTERACTIONS IN CALCIUM FLUORIDE. J. R. Reitz, R. N. Seitz, and R. W. Genberg (Case Inst. of Tech., Cleveland). Phys. and Chem. Solids 19: 73-8(Apr. 1961). (In English)

Short range interactions are assumed to have the form $\phi_{ij} = A_{ij}\exp(-r/\rho)$. By calculating the electrostatic contribution to the elastic constants of CaF and comparing the

results with the experimentally observed constants, it is determined that $\rho = 0.28 \times 10^{-8}$ cm, A_{+-} for $Ca^{2+}-F^{-}$ is 3.09×10^{-9} ergs, and A_{2-} for $F^{-}-F^{-}$ is 1.04×10^{-9} ergs. These results indicate that the $Ca^{2+}-F^{-}$ interaction is about ten times larger than the $F^{-}-F^{-}$ interaction. The deviation from the Cauchy relation is investigated by means of a model which allows relative motion between the sublattices making up the crystal. The model proves inadequate, however, and it is concluded that the failure of the Cauchy relation is due to a many-electron interaction between ions which cannot be approximated by a central interaction. (auth)

19380 NUCLEAR QUADRUPOLE COUPLING IN ALKALI IODIDE CRYSTALS. M. Menes and D. I. Bolef (Westinghouse Research Labs., Pittsburgh). Phys. and Chem. Solids, 19: 79-86(Apr. 1961). (In English)

The dynamic nuclear quadrupole interaction (first derivative of the quadrupole interaction with respect to strain) was measured for the I^{127} nucleus in crystals of CsI, RbI, KI, and NaI. These measurements were made by observing the resonant absorption of energy from an acoustic wave by the nuclear spins. Longitudinal waves propagating along a cubic axis of the crystal were used. The observed values of the dynamic nuclear quadrupole interaction are: CsI, 1600 Mc; RbI, 615 Mc; KI, 300 Mc; NaI, 660 Mc. These values can be correlated with the chemical shift of the iodine ion in these crystals with the help of a simple model based on the work of Townes and Dailey and Yosida and Moriya, which attributes the quadrupole coupling and the chemical shift to the hole left in the outer p shell of the ion. This hole is due to the distortion of the ion (admixture of excited states) by the crystal surroundings. In connection with this work, the chemical shift of LiI^{127} was measured and found to be $-3 \cdot 3 \times 10^{-4}$. (auth)

19381 PROPERTIES OF LITHIUM HYDRIDE—III. PARAMAGNETIC RESONANCE OF COLOR CENTERS. W. Burton Lewis and F. E. Pretzel (Los Alamos Scientific Lab., N. Mex.). Phys. and Chem. Solids, 19: 139-46(Apr. 1961).

Concentrations of F-centers in excess of $10^{17}/cm^3$ were produced in single crystals of LiH by neutron irradiation at 78°K. The electron spin resonance absorption of the F-centers was observed at $g = 2.004 \pm 0.001$. The saturation parameter of the ESR absorption $(T_1T_2)^{1/2}$ is close to that for F-centers in KCl. From rms line width measurements on LiH crystals of various isotopic compositions (Li^7H, Li^7D, Li^6H and Li^6D), spin densities of the F-center electron at the Li^+ and H^- sites were estimated. (auth)

19382 STRUCTURE OF URANYL NITRATE HEXAHYDRATE CRYSTAL. V. M. Vdovenko, E. V. Stroganov, A. P. Sokolov, and V. N. Zandin. Radiokhimiya, 2: 24-31 (1960). (In Russian)

Positions of uranium in uranyl nitrate hexahydrate crystals were determined and a complete description of its structure is given. The crystal consists of complex $[UO_2(H_2O)_6]^{2+}$ and NO_3^-; the chemical formula is $[UO_2(H_2O)_6](NO_3)_2$. The complex cation structure is almost identical to hydrated uranyl ions in aqueous solutions. (R.V.J.)

19383 SPECTROPHOTOMETRIC ANALYSIS OF $UO_2(NO_3)_2-ROH-H_2O_2-H_2O$ SYSTEM. A. M. Gurevich, L. D. Preobrazhenskaya, E. V. Komarov, and N. P. Osicheva. Radiokhimiya, 2: 32-43(1960). (In Russian)

Spectrophotometric and potentiometric studies were made of the $UO_2(NO_3)_2-ROH-H_2O_2-H_2O$ system with uranium concentrations of 10^{-4} to 10^{-3} M. It is shown that a gradual complexing takes place at pH 2 to 14 which depends on U concentration, ion force of the solution, order of component mixing, and other factors. A complete reversibility of the system in weakly acid and strongly basic solutions (pH 14) and a partial reversibility at pH 8 to 13 were observed. A series of compounds described by $H_2U_2O_9$, $HU_2O_9^-$, $U_2O_9^{2-}$, UO_6^{2-}, HUO_6^{3-}, $HU_4O_{13}^{5-}$, $HU_2O_{13}^{5-}$, $U_4O_{13}^{6-}$, and UO_8^{4-} were identified on the basis of data on $Na_4UO_8 \cdot 9\ H_2O$ hydrolysis. A concept of peroxide uranium compounds, stable complex uranyl ions with hydrogen peroxide anions, was developed and corresponding formulas are given. (R.V.J.)

19384 SEPARATION OF Eu RADIOISOTOPES ON MERCURY CATHODE. I. ELECTROCHEMICAL BEHAVIOR OF Eu. V. P. Shvedov and I-pei Fu. Radiokhimiya, 2: 57-64 (1960). (In Russian)

Various factors in Eu isotope separation on mercury cathodes were analyzed to verify postulations that free rare-earth ions appear during the dissociation of an amalgam complex by replacing the alkali metal in the amalgam. The yield of Eu increases with pH from 4.23 to 10.0, however, it does not vary at Eu concentration up to 3×10^{-3} M. The yield was found to be related to the concentration of complexing addend. Succinic acid, tartaric acid, and trilon B can be used instead of citric acid in the separation. (R.V.J.)

19385 ISOTOPE EFFECT AT THE CATHODE IN THE ELECTROLYSIS OF FUSED SALTS. Arnold Lundén (Chalmers Tekniska Högskola, Göteborg). Z. Naturforsch., 16a: 326(Mar. 1961). (In German)

In the electrolysis of aqueous and alcohol solutions the heavy isotopes are enriched in the residue. A study was made to determine whether this effect is present in fused salts. LiBr was electrolyzed using a molten zinc electrode. X-ray analysis showed that a Li—Zn alloy was formed during the electrolysis. The Li^7/Li^6 ratio of the metal was 12.26 and that of the salts 12.31. From a statistical "t-test", it was established that this variation is highly significant. (J.S.R.)

19386 SPECIFIC HEAT OF $GdCl_3 \cdot 6H_2O$ IN THE TEMPERATURE RANGE BETWEEN 1.1 AND 260°K. K. H. Hellwege, F. Küch, K. Niemann, and W. Pfeffer (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 162: 358-62 (1961). (In German)

The specific heat of $GdCl_3 \cdot 6H_2O$ was determined calorimetrically in the temperature range 1.1 and 260°K. For $T > 8$°K it is equal, within the measurement accuracy, to the specific lattice heat. For $T < 8$°K the specific electron heat was obtained. The specific internal heat and the specific entropy of the lattice were determined for $T < 260$°K. (tr-auth)

19387 SPECIFIC HEATS OF $HoCl_3 \cdot 6H_2O$ AND $ErCl_3 \cdot 6H_2O$ IN THE TEMPERATURE RANGE BETWEEN 1.2 AND 230°K. W. Pfeffer (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 162: 413-20(1961). (In German)

The specific heats $\underline{c}^{Ho}$ and $\underline{c}^{Er}$ of $HoCl_3 \cdot 6H_2O$ and $ErCl_3 \cdot 6H_2O$ were determined calorimetrically in the temperature range 1.2 to 230°K. Their electron fractions are equal in good approximation to the differences $\underline{c}^{Ho}-\underline{c}^{Gd}_G$ and $\underline{c}^{Er}-\underline{c}^{Gd}_G$ between the measured specific heats and the specific lattice heats of $GdCl_3 \cdot 6H_2O$ isomorphic to both salts. They agree within the calorimetric and spectrographic measurement accuracy, with the specific electron heats $\underline{c}^{Ho}_{el}$ and $\underline{c}^{Er}_{el}$ at low temperatures calculated from the spectroscopically measured crystal field splitting of the ground terms. From the pattern of $\underline{c}^{Ho}-\underline{c}^{Gd}_G$ at $T > 10$°K, it is

shown that at least three more spectroscopically unobtainable crystal field components of Ho^{3+} lie between 40 and 250 cm^{-1}. For T < 2°K, $\underline{c}^{Er} - \underline{c}^{Gd}_{G}$ shows an increase with falling temperatures which can probably be traced back to interactions between the Er ions and to hyperfine structure. (tr-auth)

19388 A STUDY OF THORON AND ITS REACTION WITH URANIUM(VI). V. A. Mikhailov. Zhur. Anal. Khim., 16: 141-9(Mar.-Apr. 1961). (In Russian)

The behavior of thoron and thoron–uranium(VI) compound on changing pH from 1 to 15 is studied. Six thoron forms are identified by the spectrophotometric method. It is shown by means of electrochromatography that thoron is positively charged in a concentrated acid, and negatively charged at pH ≥ 0. The values of successive dissociation constants of thoron are estimated to be: $pK_2 \sim 4$; $pK_3 \sim 8$, $pK_4 \sim 11.5$, $pK_5 \sim 14$. The formation of the uranium(VI)–thoron compound begins at pH 0.4; the maximum color intensity is observed at pH 4. Uranium reacts with thoron in a molar ratio of 1:1 displacing one hydrogen ion. Electroneutrality of the compound is shown by means of electrochromatography. The reaction constant of its formation at pH 0.4 to 3.5 is 25 ± 15. The values of the acid dissociation constants of uranium thoronate at pH > 6 are $pK_1 \sim 6.5$, $pK_2 \sim 11.5$, and $pK_3 \sim 14$. (auth)

19389 DETERMINATION OF THE UNSTABILITY CONSTANTS OF THE BERYLLIUM COMPLEX WITH ETHYLENEDIAMINETETRA-ACETIC ACID. L. P. Adamovich and I. N. Napadailo (Gorkii Kharkov State Univ., USSR). Zhur. Anal. Khim., 16: 158-61(Mar.-Apr. 1961). (In Russian)

The instability constant of the beryllium complex with EDTA determined by ion exchange on KY-I cationite was found to be $(1.5 \pm 0.2) \times 10^{-9}$ (for $BeHY^-$). Using this constant in calculations, the data conform to experimental data. (auth)

19390 STUDIES OF THE CRYSTALLINE STRUCTURE OF URANATES. I. URANATES WITH TETRAGONAL LAYERS $(UO_2)O_2$. L. M. Kovba, E. A. Ippolitova, Yu. P. Simanov, and V. I. Spitsyn (Moscow State Univ.). Zhur. Fiz. Khim., 35: 563-8(Mar. 1961). (In Russian)

Monocrystals of α-Li_2UO_4 and β-Na_2UO_4 were prepared and the periods of their unit cells determined. Potassium, rubidium, and cesium monouranates were investigated by the powder method and the periods of the unit cells were determined. The salts belong to the structural type K_2NiF_4; β-Na_2UO_4 may be regarded as a distorted type of K_2NiF_4 structure. The uranyl oxide pattern of Na_2UO_4 is preserved in α-Li_2UO_4, but a different distribution of the alkali metal atoms is more probable. (auth)

19391 PHYSICOCHEMICAL PROPERTIES OF SELENATES. X. HEAT OF FORMATION OF BERYLLIUM SELENATE FROM THE ELEMENTS. N. M. Selivanova and V. A. Shneider (Mendeleev Moscow Chemico-Technological Inst.). Zhur. Fiz. Khim., 35: 574-9 (Mar. 1961). (In Russian)

The heats of reaction between beryllium selenate tetrahydrate and an aqueous solution of barium chloride at 25°C are determined. The integral heats of solution in water of $BeSeO_4 \cdot 4H_2O$ and $BeSeO_4 \cdot 2H_2O$ (dilution 1:800) and of $BeSeO_4$ and $BeSeO_4 \cdot 2H_2O$ in 1N KOH (dilution 1:3600) are also measured at the same temperature. Based on the results the standard heats of formation of the crystalline salts from the elements are: $BeSeO_4 \cdot 4H_2O$, $\Delta H^0_{298.16} = -505.54$ kcal/mole; $BeSeO_4 \cdot 2H_2O$, $\Delta H^0_{298.16} = -360.82$ kcal/mole; $BeSeO_4$, $\Delta H^0_{298.16} = -213.24$ kcal/mole. (auth)

19392 POLARIZATION AND TRANSPORT OF OXYGEN IN LIQUID SODIUM. B. A. Nevzorov. Zhur. Fiz. Khim., 35: 620-3(Mar. 1961). (In Russian)

Polarization and anodic transport of oxygen are revealed on passing a 2 amp direct current through liquid sodium at 300°C from 1 to 6 hours. It is shown that in different runs the amount of transported sodium for 1 amp/hr is practically constant. The mean transport number of oxygen for uni- and divalent ions is calculated. It is proposed that the divalent oxygen ion in the form of a solvated complex is the one to polarize and to be transported. The assumption is also made that all liquid metals facilitate the dissociation of polar molecules of dissolved non-metallic impurities. (auth)

19393 PHOTOCOLORIMETRIC DETERMINATION OF THORIUM HYDROXIDE SOLUBILITY PRODUCT. P. N. Kovalenko and K. N. Bagdasarov (Rostov-On-Don State Univ., USSR). Zhur. Priklad. Khim., 34: 789-94(Apr. 1961). (In Russian)

The pH of the initial intense solubility of thorium hydroxide was found to be 3.6, and respectively, the initial precipitation pH was 3.60 to 4.10. The product of $Th(OH)_4$ activity at 22° is 2×10^{-45}. The effects of potassium nitrate on the pH of the initial $Th(OH)_4$ dissolution and on the solubility product at constant pH were analyzed. (R.V.J.)

19394 ANALITICHESKAYA KHIMIYA TORIYA. (The Analytical Chemistry of Thorium). D. I. Ryabchikov and E. D. Gol'braikh. Moscow, Publishing House of the Academy of Sciences, 1960. 296p.

The general, analytical, and separation chemistry of Th is included. The separation of Th from U^{233}, Pa^{233} and fission products and the solubility of thorium compounds are discussed separately. A bibliography of 2142 titles is appended. (R.V.J.)

19395 TSIRKONII KHIMICHESKIE I FIZICHESKIE METODY ANALIZA. (Zirconium, Chemical and Physical Methods of Analysis). S. V. Elinson and K. I. Petrov. Moscow, Atomizdat, 1960. 212p.

An analysis is made of the practical problems in the analytical chemistry of zirconium. Verified, practiced chemical and spectral methods of zirconium analysis are described. Dissolution of Zr and Zr alloys, separation of Zr from admixtures, and the determination of admixtures in zirconium are discussed. (R.V.J.)

19396 X-RAY DIFFRACTION INVESTIGATION OF BeO CALCINATION PROCESSES. R. C. Rau (General Electric Co., Cincinnati). p.19-39 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

Investigations were performed to determine the various phases and transformation temperatures occurring in the different BeO calcination processes and to determine the theoretical density of the final BeO product. The hydroxide, sulfate, and oxalate of Be were the starting materials in the three calcination series. Samples were prepared by heating small portions of the starting materials for 1 hr at various temperatures and slow cooling. The hydroxide series showed a direct conversion from $Be(OH)_2$ to BeO by simple loss of water but the sulfate series and the oxalate series go through a series of intermediate phases in transforming to BeO. X-ray data and structure information were obtained for most of these phases, and temperature ranges of their occurrence were established. Some x-ray results were compared with results of stereoscopic and polarizing microscope examinations, and temperature range of occurrence was compared with thermal balance curves. (auth)

Radiation Chemistry and Radiochemistry

19397 (AERE-M-564) THE PRODUCTION OF CHEMICALS FROM REACTORS. PART IV. PRELIMINARY EXPERIMENTS OF THE FISSION FRAGMENT INDUCED FIXATION OF ATMOSPHERIC NITROGEN AT HIGH TEMPERATURES AND PRESSURES. F. Moseley, A. E. Truswell, and C. G. Edwards (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1959. 8p.

Fission-fragment irradiations of dry air at ~100°C established that the G value for acidic nitrogen oxide production increases with increasing pressure. At 400 psia, the highest pressure examined, $G_{NO_2} = 1.55$. In the presence of traces of water vapor under otherwise similar conditions, G_{NO_2} increases to 1.90. An experiment carried out at 400 psia and 250°C increased the value of G_{NO_2} to about 3.0. The G values reported are not yet high enough to permit competition with existing methods of nitric acid manufacture. There may be scope, however, for a further increase in G value under suitable experimental conditions. (auth)

19398 (AFOSR-TN-60-1269) CHEMICAL EFFECTS OF RADIATION. W. F. Libby (California. Univ., Los Angeles). Sept. 30, 1960. Contract AF49(638)-901. 68p. (AD-247702)

Discussions are given of the theory of the chemistry of ions, the chemistry of neutron moderation, size effects among isotopic molecules, optical transparency and resistance to flash heating in nose cones, the composition and properties of uranium oxides, and tritium geophysics. A tritium water list is given showing tritium levels in rainfall, wells, lakes, rivers, and sea waters at various locations. (B.O.G.)

19399 (NAS-NS-3033) THE RADIOCHEMISTRY OF ANTIMONY. William J. Maeck (Phillips Petroleum Co.). Feb. 1961. 60p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review is presented of the nuclear and chemical features of particular interest to the radiochemist. Sample dissolution and counting techniques are discussed and a collection of radiochemical procedures for the element as found in the literature is included. (J.R.D.)

19400 (NAS-NS-3034) THE RADIOCHEMISTRY OF TITANIUM. Chong Kuk Kim (Univ. of Michigan). Mar. 1961. 27p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The chemistry and radiochemistry of titanium are reviewed. Complexes of titanium and its extraction and ion exchange properties are discussed. Collected counting techniques and radiochemical separation procedures are presented. (D.L.C.)

19401 (NAS-NS-3035) THE RADIOCHEMISTRY OF CESIUM. H. L. Finston and M. T. Kinsley. (Brookhaven National Lab.). Feb. 1961. 75p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A comprehensive review of the chemistry and radiochemistry of cesium is presented. Dissolution of samples containing cesium is discussed, and analytical methods, counting techniques, and radiochemical procedures are presented. Applications of cesium radioisotopes are discussed briefly. (D.L.C.)

19402 (NAS-NS-3036) THE RADIOCHEMISTRY OF GOLD. J. F. Emery and G. W. Leddicotte (Oak Ridge National Lab., Tenn.). 45p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

19403 (NP-10178) PARAMAGNETIC RESONANCE IN THE SOLID STATE. Quarterly Progress Report No. 11. January, February, March 1961. Hartmut Kallmann (New York Univ., New York). Apr. 1961. Contract DA 36-039 sc-78056. 34p.

The scavenger efficiency of DPPH in benzene and in carbon tetrachloride was found to be essentially constant between 5×10^{-4} and 5×10^{-3} moles/liter. The ratio of the rate of radical formation in carbon tetrachloride to the rate in benzene is 240 to 1 for the same incident x-ray intensity. For equal absorption of energy, the ratio is about 50 to 1. At low temperature and low microwave power, the EPR spectrum of excited zinc sulfide copper activated phosphor consists of seven well resolved lines. The strong central line is caused by trapped electrons and the four equally spaced lines are the result of the Cu (II) ions. (auth)

19404 (NYO-9107) A STUDY OF THE MECHANISM OF RADIATION INDUCED GELATION IN MONOMER-POLYMER MIXTURES. Quarterly Summary Report, February 1, 1961 to April 30, 1961. (Radiation Applications Inc., Long Island City, N. Y.). Contract AT(30-1)-2554. 7p.

The degree of equilibrium swelling of low density polyethylene by various di- and tri-functional monomers was experimentally determined. Non-extractable portions of irradiated monomer-polymer and monomer-free-polymer samples were determined by refluxing in a Soxhlet extractor. Irradiated, monomer-free polyethylene samples that gave a non-extractable portion after Soxhlet refluxing dissolved by direct immersion in the same hot solvent. (auth)

19405 (PAN-197/V) HOT ATOM CHEMISTRY OF HALOGENS ACTIVATED IN β-DECAY. I. THE CHEMICAL STATE OF ^{131}I FROM ^{131}Te-LABELLED DIBENZYL TELLURIDE. A. Halpern and R. Sochacka (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 15p.

The present study concerns the bond rupture in Te^{131}-labeled dibenzyl telluride as result of β-decay. The percentage yields of the I^{131} activity in benzyl iodide, methyl iodide, phenyl iodide, iodotoluene and inorganic forms are determined. It is established, that in 98 percent of events the Te-C bond is ruptured. The influence of the phase effect and of the scavengers added is also studied. The hypothesis is put forward that the I^{131} atoms activated in β-decay do not undergo high-energy reactions. (auth)

19406 (PAN-206/ChR) INFLUENCE OF γ-RADIATION ON CELLULOSE PULP, FIBRE AND FOIL OF POLISH PRODUCTION. J. Zurakowska-Orszagh and J. Pieniazek (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 7p.

The effects of gamma radiation on cellulose pulp, cellulose fiber, and cellulose foil were investigated. (auth)

19407 (PAN-207/ChR) POLYMERIZATION OF METHACRYLAMIDE IN THE SOLID STATE UNDER THE INFLUENCE OF γ-RADIATION. J. Zurakowska-Orszagh and T. Achmatowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 4p.

The effects of oxygen on radioinduced polymerization of methacrylamide in solid state were investigated using gamma radiation. (auth)

19408 (TID-7597(p.46-75)) HIGH FLUX EXPERIMENTS IN THE SYSTEM CO_2/CO/GRAPHITE. H. Cowen and R. Lind (United Kingdom Atomic Energy Authority.

Development and Engineering Group, Windscale, Cumb., England).

Experiments were carried out in DIDO on the CO_2/CO/graphite reaction in order to study the system under high-flux conditions. The studies were carried out at high radiation intensities and under "slow-bleeding" or "semi-static" conditions of gas flow. The first series of experiments was carried out in a 2 v hole at atmospheric pressure. The second was conducted at 10 atm pressure in a 6 v hole. Both sets of experiments irradiated a proportionality between reaction rate and flux. The 6 v work also indicated direct proportionality with pressure. Results indicated that an important role is played by the pore structure of the graphite. (M.C.G.)

19409 (TID-7597(p.76-123)) THE REACTION BETWEEN CARBON AND CARBON DIOXIDE UNDER IRRADIATION. T. B. Copestake and N. S. Corney (General Electric Co., Ltd. Research Labs., Wembley, England).

The reaction between carbon and carbon dioxide under pile and γ irradiation was studied in sealed silica bulbs. Irradiation-promoted degassing was not found to play an important part in the reaction. The rate of carbon monoxide production decreased with increasing radiation dose. The initial rate of carbon monoxide production was found to depend on the amount and geometry of the carbon and on the amount and pressure of the carbon dioxide but not markedly on the nature of the carbon. The utilization of gas irradiated within the pores was compared with that irradiated outside the geometrical surface for two sizes of graphite specimens. Gas irradiated sufficiently remote from the carbon was utilized ineffectively. Irradiations at 500°C indicated that the radiation-induced reaction can have only a small temperature coefficient. An experiment relying on electrically heated carbon filament irradiated in a carbon dioxide atmosphere failed to detect gasification of the carbon. Carbon dioxide decomposed under irradiation to give carbon dioxide and a solid, the properties of which depended on the temperature of formation. (auth)

19410 (TID-7597(p.124-47)) IRRADIATION EFFECTS ON CARBON MASS TRANSPORT BY IMPURITIES IN HELIUM. W. L. Kosiba (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Experiments were carried out to determine the effects of reactor irradiation on a system composed of metals and graphite in a helium stream that contained impurities. The metals were Ni, K-Monel, and Nb–Zr. Some evidence was found that irradiation affects the mass transport of carbon by impurities in the helium coolant stream. The weight changes for the metals were consistently greater for the unirradiated specimens than for the irradiated ones. Consistent with these data were the larger microhardness values obtained for the unirradiated specimens. One explanation of these results is the formation of a thicker oxide layer on the unirradiated metal and a radioinduced hydrogen reduction of the metal oxide on the irradiated metal specimens. Metallographic examinations revealed no serious attack on the metal specimens in either the irradiated or unirradiated capsule. The bulk of the impurities in the coolant stream was caused by the outgassing of the graphite, and zirconium proved to be an efficient getter for these impurities in the absence and presence of reactor radiation. (M.C.G.)

19411 (TID-7597(p.148-72)) THE RADIATION-INDUCED CO_2/GRAPHITE REACTION—A TENTATIVE VIEW OF THE MECHANISM. J. Wright (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The behavior of the system CO_2–CO–C under radiation was investigated. Experiments showed that the processes of most concern resulted from absorption of energy in the gas phase. A mechanism was formulated to account for all observations on the purely gas-phase processes. No observations on the system are at variance with the mechanism proposed. It is possible to give a qualitative interpretation to most of these observations in terms of a competition between the gas phase and the heterogeneous destruction of the oxidizing species. The reaction processes were found to be independent of temperature and proportional to radiation intensity and energy absorption in the gas phase. (M.C.G.)

19412 (TID-7597(p.191-206)) ON THE POSSIBILITY OF RADIATION INDUCED TRANSPORT OF CARBON IN HELIUM. I. N. Onslow MacAulay and M. Tomlinson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The possibility of a radiation-induced reaction between helium and graphite was investigated. Theoretical treatment indicated that there is little likelihood of significant transport of carbon occurring in a reactor system by the mechanism postulated. A stream of purified helium was passed through a fused quartz reaction tube where a helium plasma was generated by microwave radiation fed in from a director placed close to the tube. Carbon specimens were suspended in the middle of the plasma until there were visible signs of carbon removal. Results indicated that the transport of the carbon can be attributed to attack by impurities and if there was any attack by the helium itself, this was not distinguishable. (M.C.G.)

19413 (TID-7597(p.248-51)) THE USE OF CARBON CONTAINING C^{14} IN STUDIES OF THE RADIATION-INDUCED REACTIONS WITH CO_2 AND CO. John Wright (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

An investigation is being made of the transport of carbon in the presence of mixtures of CO_2 and CO using C^{14} incorporated in the solid-phase carbon only. Preliminary results indicate that, although there is some evidence for decrease in carbon transport from solid to gas as the CO concentration increases, it is still possible to get a substantial carbon transport even on irradiation in pure CO. (M.C.G.)

19414 (CEA-tr-R-1264) SUR LES PRODUITS INTERMEDIAIRES DE LA RADIOLYSE DE L'EAU. (On the Intermediate Products in the Radiolysis of Water). M. A. Proskurnin (Proskurpin) and V. A. Sharpatyi. Translated into French from Zhur. Fiz. Khim., 24: 2126-8(1960). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 2676.

19415 (CEA-tr-X-275) DISPOSITIF POUR LE PRÉLÈVEMENT D'ÉCHANTILLONS DE LIQUIDES, EN PARTICULIER DE LIQUIDES RADIOACTIFS. (Apparatus for Withdrawing Samples of Liquids, Especially Radioactive Liquids). Translated into French from Dutch Patent No. 219,634, Aug. 5, 1957. 7p.

An apparatus for withdrawing samples of liquids, especially radioactive liquids, is described. The apparatus consists of a tank provided with an air outlet, a reservoir above the tank, a vacuum receptacle, a sampling enclosure, a stopcock system, tubing connecting the upper part of the reservoir with the vacuum receptacle, leads between the reservoir and tank, and an overflow outlet. The apparatus

is explained in detail by means of a schematic reproduction. (J.S.R.)

19416 (CEA-tr-X-342) L'APPLICATION DE LA MÉTHODE DES CRISTAUX BRUTS EN VUE DE LA PRODUCTION D'ISOTOPES RADIOACTIFS SANS ENTRAINEUR. (Application of the Method of Unfinished Crystals to the Carrier-Free Production of Radioisotopes). B. Toth. Translated into French from Maygar Tudomanyos Akad. Kozponti Fiz. Kutato Intezetenek Közlemenyei, 7: 417-21 (1959). 15p.

The partition coefficients, determined by the isothermal method, were experimentally controlled, and the Doerner-Hoskins crystal system was created. In this system the distribution of Ba^{140} and Sr^{90} (microcomponents) between the solid phase of $PbSO_4$ (macrocomponents) and its saturated aqueous solution was examined. It was found that the partition coefficients, determined by the isothermal method and by experimental measurements, agree within the limits of experimental error. (tr-auth)

19417 USE OF SUBMICRON SILICA TO PREVENT COUNT LOSS BY WALL ADSORPTION IN LIQUID SCINTILLATION COUNTING. F. A. Blanchard and I. T. Takahashi (Dow Chemical Co., Midland, Mich.). Anal. Chem., 33: 975-6(June 1961).

Use was made of the adsorption by Cab-O-Sil M5 Silica 99.0 to 99.7% SiO_2) in controlling counting losses. Adsorbing compounds, when counted without silica, gave low initial count rates. Using silica they gave stable values over a period with count rates as high as homogeneous systems. Nonadsorbing compounds gave equally good efficiencies (48 to 50%) with or without silica. (P.C.H.)

19418 OXIDATIVE RADIOLYSIS OF AMINO ACIDS, PEPTIDES AND PROTEINS IN AQUEOUS SOLUTIONS BY GAMMA IRRADIATION. Hiroyuki Hatano (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 120-32(Mar. 1961).

Ammonia yield of amino acid deamination was not affected over a wide range of irradiation doses while the yield increased with the concentration. α-amino groups were librated more easily than β- groups, β more easily than γ. In amino sulfonic acid the deamination of the amino acids took place less readily than in amino carboxylic acid. In the libration of ammonia in γ-irradiated peptide and protein solutions, not only free amino groups but also peptide bonds were proved to contribute. α-keto acid was found to be produced from its parent amino acid by γ-irradiation in oxygen-containing aqueous solutions. α-keto acid 2,4-dinitrophenylhydrazones were derived from the α-keto acids. They were characterized and determined spectrophotometrically and chromatographically. Reaction yield of α-ketoglutaric acid obtained from γ-irradiated glutamic acid was also affected by irradiation conditions. The yield of decomposed α-alanine was identical stoichiometrically with that of liberated ammonia, while the yield of pyruvic acid from alanine was smaller than that of decomposed alanine and of librated ammonia. Further decomposition of the pyruvic acid by larger doses of γ rays, was observed in aqueous solutions. (auth)

19419 FREE RADICALS OF GAMMA-RAY IRRADIATED AMINO ACIDS AND SOME SUBSTANCES OF BIOLOGICAL INTEREST STUDIED BY ELECTRON SPIN RESONANCE ABSORPTION. Yasuo Imai (Kyoto Univ.), Akira Inouye, Kiyoshi Sugibuchi, Akira Hirai, and Sadaharu Toyoda. Bull. Inst. Chem. Research, Kyoto Univ., 39: 138-52(Mar. 1961).

Investigations were made of electron spin resonance (ESR) signals of gamma-irradiated amino acids, peptides, and proteins. ESR absorption of 10^4 to 10^7 r irradiated amino acids, peptides, and proteins show characteristic curves. The signals of those which contain sulfhydryl or disulfide groups show essentially the same pattern as those of S· or S⁻⁻S. The concentration of the free radical electron in the irradiated protein (about 10^{18} spins per gram) is lower than those of amino acids and peptides (about 10^{19} spins per gram). When irradiation was made in the presence of oxygen, the signals of irradiated protein show a marked difference from those irradiated in vacuo or in the presence of nitrogen. The protein irradiated in the presence of water shows a rapidly decaying ESR signal. UV irradiation also produces in protein and nucleic acids considerable free radicals. Some discussions were made on the radiation damage of the biologically interesting materials from these results. (auth)

19420 A COBALT-60 IRRADIATION FACILITY FOR RADIATION CHEMISTRY. Toshifumi Saigusa (Sumitomo Atomic Energy Industries, Ltd., Takarazuka, Japan), Shozo Horikiri, Masatsune Kondo, and Sakae Shimizu (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 166-79(Mar. 1961).

Some details of design and construction of a 2000-c Co^{60} facility are described. Dosimetry for the γ field was carried out with ferrous-ferric dosimeters and Victoreen Radocon r-meters. The theoretical estimation of dose rates was also performed by adopting some assumptions on configuration and arrangement of sources. The comparison between both estimations of dose rates, experimental and calculated, is discussed. (auth)

19421 DETERMINATION OF THE SPECIFIC ACTIVITY OF TRITIATED COMPOUNDS ON PAPER CHROMATOGRAMS USING AN AUTOMATIC SCANNING DEVICE. F. J. Carleton and H. R. Roberts (National Dairy Products Corp., Oakdale, N. Y.). Intern. J. Appl. Radiation and Isotopes, 10: 79-85(Apr. 1961). (In English)

The specific counting of low-energy beta emitters has heretofore involved complex radiochemical procedures. Paper chromatography offers a simpler means of separating components of complex mixtures. An automatic scanning device allows radiochemical counting procedures to be done directly from the paper chromatograms. Quantitative assays of specific tritiated compounds are made directly from paper chromatograms. The method of calibration is described. (auth)

19422 RADIOCHEMICAL GRAFTING BY MEANS OF LOW TEMPERATURE IRRADIATION. J. R. Puig and J. Dobó (Centre d'Etudes Nucléaires, Saclay, France). Intern. J. Appl. Radiation and Isotopes, 10: 112-15(Apr. 1961). (In French)

Radiochemical grafting of styrolene onto polyethylene is achieved by the simultaneous irradiation of the polymer and the monomer at low temperature. Grafting takes place almost entirely after the irradiation when the specimen has warmed up to room temperature. The reaction is all the more efficient if the polymer is free of reducing agent. The presence of molecular oxygen appears to hinder homopolymerisation and to favor copolymerisation. The samples produced are free from homopolymer occlusion like those obtained by preirradiation in a vacuum. The conditions required for a homogeneous distribution of grafts in the thickness of the polymer are discussed. (auth)

19423 THE PREPARATION OF CURIE QUANTITIES OF S^{35} LABELLED ELEMENT SULPHUR. H. L. Otto (Centraal Laboratorium T.N.O.; Delft, Netherlands) and M. Winand. Intern. J. Appl. Radiation and Isotopes, 10: 130-1(Apr. 1961). (In English)

Sulfur-35 is obtained by irradiating KCl according to $Cl^{35}(n,p)S^{35}$. The sulfur is isolated as carrier-free sulfuric

cid which still contains a large excess of 1N hydrochloric cid. Quantities of 5 to 25 mg atoms of elemental sulfur vith specific activities up to 100 mc/mg atoms, or even igher, are easily obtained in 95 to 100% yields. Carrier odium sulfate is added to the sulfate-S^{35} solution in order o arrive at the desired specific activity. A mixture of ulfate, hydrogen iodide, red phosphorus, and formic acid s warmed in a slow stream of nitrogen, and the hydrogen ulfide evolved is absorbed in a dilute solution of sodium ydroxide. The alkaline solution of sulfide is oxidized vith a mixture of potassium ferricyanide and potassium arbonate in the presence of benzene. Oxidation takes lace gradually; than the benzene dissolves the sulfur im- nediately when formed and the precipitation of insoluble morphous sulfur is avoided. A carefully adjusted quantity f potassium carbonate is added together with the potas- ium ferricyanide to maintain pH 9 during the oxidation. The sulfur separates out in crystals when the benzene is vaporated in a slow stream of nitrogen. (N.W.R.)

19424 SYNTHESIS OF COPOLYMER GRAFTS ON POLYMERS PREVIOUSLY EXPOSED TO IONIZING RADIATION. III. COMPARATIVE STUDIES OF GRAFTING ON POLYETHYLENE AND POLYPROPYLENE. Adolphe Chapiro (Faculté des Sciences, Paris). J. Polymer Sci., 8: No. 150, 109-20(Dec. 1960). (In French)

The kinetics of the grafting of acrylonitrile on a low pressure polyethylene and on polypropylene, both prepared with the same catalyst, were compared. The two polymers were preirradiated by γ rays in the presence of air, and then warmed under vacuum in the monomer at different temperatures. The shape of the conversion curves varies with preirradiation dose. For high doses, the grafting reaction is at first very fast, but rapidly stops for a limiting value of grafting. This limiting value is smaller, the higher the preirradiation dose. The relationships between the grafting rate and the dose and intensity of preirradiation are different for polyethylene and polypropylene. The same applies to the influence of temperature on the grafting reaction. The amount of homopolymer formed (polyacrylonitrile) is much greater in the case of grafting on polypropylene. The radiochemical peroxidation leads mainly to hydroperoxides POOH for polypropylene and to diperoxides POOP for polyethylene. In the case of polypropylene, the reaction is controlled by the rate of diffusion of the monomer in the polymer film. The difference in the mp for crystallites of polyethylene and polypropylene gives an understanding of the effect of the grafting temperature on the kinetics observed in the two systems. (auth)

19425 STARTING FORMALDEHYDE POLYMERIZATION WITH IONIZING RADIATION. Claude Chachaty, Michel Magat, and Leon Ter Minassian (Faculté des Sciences, Paris). J. Polymer Sci., 48: 139-49(Dec. 1960). (In French)

Polymerization with γ and x rays was studied in the range $-75°$ to $-196°$, using mostly the thermoanalytical method. The doses of radiations used, although usually less than 1000 r, cause high degrees of conversion. At the lowest temperatures the polymerization behaves explosively, either on warming up or during the irradiation itself, depending on the dose. This type of polymerization was interpreted in terms of an internal warming up due to the accumulation of growing chains. An increase of a few degrees in internal temperature with respect to the temperature external to the reaction medium is sufficient to provoke an explosion. An activation energy of about 3 kcal/ mole was determined. At higher temperatures the polymerization proceeds in a thermally stationary state, because the chain initiation and termination occur during the irradiation. (auth)

19426 ON THE STRUCTURE OF POLYETHYLENE GRAFTS WITH PREIRRADIATION TECHNIQUE. Claude Sella (CNRS, Bellevue, France). J. Polymer Sci., 48: 207-18(Dec. 1960). (In French)

The structure and morphology of copolymers obtained by grafting styrene, vinyl acetate, acrylonitrile, and methyl methacrylate monomers onto polyethylene preirradiated with γ rays were investigated by x-ray analysis and electron microscopy. Analysis of the x-ray diagrams at large angles permits the changes in crystallinity of the polymers subjected to grafting as well as deformation of the crystal lattice to be followed as function of the nature, frequency, and length of the molecules grafted onto the polyethylene backbone. The grafting reaction is heterogeneous, leading to the coexistence of three phases, namely, nongrafted polyethylene, grafted copolymer, and homopolymer. Electron microscopy demonstrated the form and distribution of the precipitated homopolymer as functions of grafting conditions (preliminary radiation, temperature, etc.) and preliminary thermal treatment (annealing, quenching, etc.) of the graft copolymer. (auth)

19427 SOME CHEMICAL EFFECTS OF IONIZING RADIATIONS ON NUCLEIC ACIDS AND RELATED COMPOUNDS. G. Scholes, J. F. Ward, and J. J. Weiss (King's Coll., Newcastle upon Tyne, Eng.). J. Polymer Sci., 48: No. 150, 301-8(Dec. 1960). (In English)

The degradation of desoxyribonucleic acid (DNA) by irradiation of its aqueous solutions with ionizing radiations in the presence of oxygen is discussed in terms of the reactions of free radicals with the different molecular entities of the macromolecule. The attack of the radicals on the purine and pyrimidine bases is a major effect of the irradiation. In the presence of O an important radiation-induced reaction is the formation of peroxidic compounds from the pyrimidines. Breakage of the strands in the DNA helix is apparently due mainly to an attack of the radiation-produced radicals on the sugar moieties which leads to a splitting of the phosphate ester linkages along the chains. The extent of attack which leads to breakage of internucleotide bonds, leading to the production of phosphomonoester groups, was determined directly: the number of endgroups formed on irradiation with 200 kv x rays corresponds to a yield of $G \simeq 0.5$ (endgroups/100 ev). Rupture of hydrogen bonds within the helix is a consequence of chemical changes in the polynucleotide chains; several hydrogen bonds can be broken following a single chemical event. The hyperchromic effect which is observed in the action of the radiations on nucleic acids in solutions was investigated in some detail. It is concluded that this effect is caused, in general, by environmental changes of the chromophoric groups of the purine and pyrimidine bases of the DNA, and is due to the change of the nature of the hydrogen bonding of the bases within the intact helix, where the bases of one strand are bonded to the bases of the complementary strand, to hydrogen bonding with water molecules when the latter have penetrated between the strands of the helix. (auth)

19428 INFLUENCE OF IONIZING RADIATION ON POLYMERIZABLE SYSTEMS. M. Magat (Faculté des Sciences, Paris). J. Polymer Sci., 48: No. 150, 379-91 (Dec. 1960). (In French)

The most essential results concerning the polymerization of vinyl monomers induced by ionizing radiations and proceeding through a radical mechanism are pointed out. Three more recent fields of research are examined, namely, the production of graft polymers, ionic polymerization, and polymerization in the solid state. The most spectacular successes have been achieved in this last case and the problems appear the most complicated. It has appeared more recently that practically any monomer could be polymerized in the solid state, even at low temperatures. The proofs that polymerization proceeds effectively in the solid states were examined; the influence of the solid state, as much on the total rate as on the rate of propagation and the rate of termination, was considered. The determination of the true mechanism (ionic or radicalar) of these polymerizations presents many difficulties. Finally, "explosive" polymerization of solid monomers was considered; it can be interpreted with the use of Semenov's theory on thermal explosions. (auth)

19429 RADIATION GRAFTING OF ALLYLIC MONOMERS TO SOLID POLYMERIC SUBSTRATES. J. Zimmerman (E. I. du Pont de Nemours and Co., Wilmington, Del.). J. Polymer Sci., 49: 247-52(Feb. 1961).

The kinetics of grafting of allylic monomers to a solid polymeric substrate are compared with those for normal vinyl monomers. The case treated theoretically for both types of monomers is the sequence where the polymer is soaked in a solution of the monomer, the excess monomer is removed from the surface, the polymer is then irradiated at −78°C at a high dose rate, and the system subsequently allowed to condition at 25°C under an oxygen free atmosphere. It was previously shown theoretically that with a normal vinyl monomer in a very viscous matrix, the conversion of monomer to polymer increases indefinitely with post-irradiation time and that radiation dose and post-irradiation time are interchangeable in the absence of inhibitors. It is shown here that under similar conditions with allylic monomers, the existence of degradative chain transfer to the monomer places a definite limit on the maximum conversion and makes this conversion quite dependent on dose. The theory for the case involving degradative chain transfer is applied to data on the grafting of itaconic acid to 66 nylon and values are deduced for the ratio of transfer to propagation constants and transfer to termination constants. Lower limits for the absolute values of these constants are also deduced. The ratio of propagation k_p and termination k_t rate constant in this very viscous medium is $k_p/2k_t = 0.58$. (auth)

19430 SOLID STATE POLYMERIZATION OF FORMALDEHYDE INDUCED BY IONIZING RADIATION. Yoshizo Tsuda (Toyo Rayon Co., Ltd., Otsu, Japan). J. Polymer Sci., 49: 369-76(Feb. 1961).

Irradiation with gamma rays or electrons of solid formaldehyde at −196°C induces polymerization, which proceeds explosively on warming. The G value for conversion was much larger than those of any other radiation polymerizations. Polyoxymethylene of very high molecular weight was obtained in bulk and in solid solution irrespectively of dose rate and irradiation time. Acrylonitrile was found also to polymerize explosively on warming the solid monomer irradiated at −196°C. It was concluded that ions or highly excited molecules formed from the irradiation at −196°C are trapped in the solid state and that they initiate the polymerization on warming the irradiated solid monomer. (auth)

19431 COLOR AND RADICAL FORMATION IN IRRADIATED POLYVINYL CHLORIDE. G. J. Atchison (Dow Chemical Co., Midland, Mich.). J. Polymer Sci., 49: 385-95(Feb. 1961).

A visible color change varying through green-yellow to deep red-black is produced, depending upon dose and temperature. Spectrophotometric and electron spin resonance techniques were used to investigate the formation of colored material by 2 Mev electron irradiation of unplasticized PVC moldings. Colored polyene structures were formed. Three radiation-produced free radicals decaying at room temperature with half lives of 4.5, 63, and 1630 hr were observed. The color in the 550 mμ region was found to be inversely proportional to the concentration of the long-lived radical. The presence of absorption maxima in the 350 to 500 mμ region was observed in irradiated moldings and in tetrahydrofuran solutions of irradiated moldings. (auth)

19432 RADIATION EFFECT ON CATALYSTS AND THE INFLUENCE OF CATALYSTS ON RADIOLYTICAL REACTIONS. M. Haissinsky (Institut du Radium, Laboratoire Curie, Paris). Jaderná energie, 7: 73-8(1961). (In Czech.)

In spite of a very limited knowledge of the influence of radiation on catalysts and of catalysts on radiolytical reactions it is evident that this influence is not universal. It is dependent simultaneously on the nature, dimensions and on the mode of preparation of a solid substance, on the nature of reactions and probably on experimental conditions as well. In some investigated systems the radiation performs no effect on the catalysis, in others the radiation retards or accelerates the catalysis and the effects are generally poor (factor less than 10) with the exception of two or three reactions. Less effective catalysts in thermal reactions show more expressive effects than good catalysts. The effect of catalysts on radiolytical reactions depends on the mode of their preparation and on the nature of a reaction. The generalization and the creation of hypotheses of mechanism of these processes needs still more systematic investigations. (auth)

19433 POLYMERIZATION BY IONIZING RADIATION. R. Häberli (Institut für Reaktorforschung, Würenlingen, [Switzerland]). Neue Tech., 3: 143-50(Mar. 1961). (In German)

After pointing out some general aspects of radiation chemistry, the basis of radiation chemical radical polymerization is described. Polymerization in the solid state (solid state reactions) is especially discussed. New fields of radiation chemical polymerization are discussed such as ionic polymerization and polymerization of monomers which can only be polymerized by ionizing radiation. (auth)

19434 PREPARATION OF Ag^{111} FROM NEUTRON IRRADIATED PALLADIUM. V. I. Levin, N. G. Serebryakov, and I. V. Meshcherova. Radiokhimiya, 2: 120-6(1960). (In Russian)

Separation of Ag^{111} from neutron irradiated Pd by isotopic exchange with AgCl precipitant was studied. Radiochemical analysis of the remaining Pd^{103} indicated admixtures of Ag^{110} not exceeding 0.05%. (R.V.J.)

19435 STUDIES OF SOME PROBLEMS RELATED TO THE INTERACTION OF BETA RAYS WITH MATTER. Torbjörn Westermark (Royal Inst. of Tech., Stockholm). Svensk Kem. Tidskr., 73: 153-9(1961). (In English)

Studies were made of energy loss by monoenergetic electrons, applications of P^{33} labelling of organic compounds, the chemical actions of gaseous ions in liquids and gels, and chemical and luminescence effects due to stored energy in solids. The studies contribute to the understanding and investigation of practical applications. Together the papers form a thesis. (P.C.H.)

19436 THE INDIRECT EFFECTS OF X-RAY BEAMS ON LYSINE. Gernot Peter, Theodor Wieland, and Boris Rajewsky (Universität, Frankfurt am Main and Max-Planck-Institut für Biophysik, Frankfurt am Main). Z. Naturforsch., 16b: 198-206(Mar. 1961). (In German)

A study was made to obtain proofs of indirect radiation effects and to detect the individual steps which occur in aqueous lysine solutions. For investigation of the effects caused by HO_2 or OH radicals, two research series were carried out: irradiation in the presence of oxygen and irradiation under oxygen deficiency. Also the effect of the dose, dose output, temperature, and various substrate concentrations was investigated. An attempt was made to explain the experimental results with the help of radical effects which were extended to decarboxylation, deamination, and changes of the carbon structure. (tr-auth)

19437 APPLICATION OF ELECTRICAL CONDUCTIVITY MEASUREMENTS TO THE STUDY OF THE RADIOLYSIS OF WATER. Klaus Schmidt (Max-Planck-Institut für Biophysik, Frankfurt am Main). Z. Naturforsch., 16b: 206-17(Mar. 1961). (In German)

The conductivity behavior of pure aerated water was investigated under continuous and pulsed x radiation (60 kv_s). Two effects overlying each other were found: an irreversible conductivity increase which is proportional to the x-ray dose and which is probably due to a radiation reaction of the dissolved CO_2 and a reversible conductivity increase during the irradiation which can be explained by the origin of an ion type with a mean life of about 0.15 sec. The ion is assumed to be $\cdot C_2^{\ominus}$, formed by the reaction of H radicals with dissolved oxygen. A possible chemical reaction mechanism is given which leads to satisfactory quantitative agreement of the results with yield values and reaction constants from the literature. (tr-auth)

19438 THE ACTION OF Co^{60} GAMMA RADIATION ON ESTERS OF PHOSPHORIC ACID. V. P. Shvedov and S. P. Rosyanov (Lensoviet Inst. of Tech., [USSR]). Zhur. Fiz. Khim., 35: 569-73(Mar. 1961). (In Russian)

The action of γ rays from a Co^{60} source on liquid tributyl, tripropyl, and triethyl phosphates is investigated. With the aid of paper chromatography it is shown that on irradiation of trialkyl phosphates various phosphorus containing products are formed, among which the principal are the corresponding di- and monoalkylphosphoric acids. The accumulation of di- and monoalkylphosphoric acids is investigated and their radiochemical yields are determined. (auth)

19439 RADIATION CHEMISTRY OF GASES. Samuel C. Lind. American Chemical Society Monograph Series No. 151. New York, Reinhold Publishing Corporation, 1961. 322p. $12.50.

Experimental work in the use of ionizing radiation to effect chemical reactions is covered with special stress placed on the effect of foreign gases mixed with reactants. Both physical principles and gaseous reactions developed from 1928 to July 1, 1960 are covered. Special emphasis is placed on experimental results, such as reaction rates, products, and ion yield rather on theoretical or speculative efforts to outline details of reaction mechanisms. Although having no direct application to gases, a full discussion of dosimetry of water and of aqueous solutions is included. Other experimental work covers reactions of a single component, oxidation, hydrogenation, nuclear processes, oxides of nitrogen, various parameters, and electric fields. (N.W.R.)

19440 IMPROVEMENTS IN OR RELATING TO CROSS-LINKED POLYOXYMETHYLENES AND PROCESSES FOR THEIR PREPARATION. (to E. I. du Pont de Nemours and Co.). British Patent 863,176. Mar. 15, 1961.

A process for producing cross-linked polyoxymethylenes and manufactured articles from them is discussed. Cross-linked polyoxymethylene is prepared by subjecting a mixture of a polyoxymethylene containing at least 100 oxymethylene units per molecule and an ester, amide, or imide containing at least 2 non-adjacent ethylenic groups. The ethylenic groups are in a terminal position or in conjugation with the oxygen atom in the C=O group of the amide, imide, or ester radical and are subject to either ionizing radiation or ultraviolet light in the presence of a photoinitiator. The ionization radiation and ultraviolet light methods are described. The process for the production of cross-linked poloxymethylenes containing at least one cross-link per 10,000 oxymethylene units is also discussed. The best results are attained if from 0.5 to 20% of the selected poly-unsaturated compounds, and from 0.01 to 5% by weight of the compounds of the photoinitiator are employed. The product is a cross-linked polyoxymethylene which is less thermoplastic than untreated polyoxymethylene and may be used in fabrics, fibres, and films. (N.W.R.)

Raw Materials and Feed Materials

19441 (ORNL-3012) DIRECT REDUCTION OF URANIUM HEXAFLUORIDE TO URANIUM METAL BY SODIUM (DRUHM PROCESS). C. D. Scott (Oak Ridge National Lab., Tenn.). May 24, 1961. Contract W-7405-eng-26. 27p.

The chemical feasibility of the direct, continuous reduction of UF_6 to U with Na was shown in several tests. Up to 93.5% of the U content of UF_6 continuously reduced by Na in a reaction vessel was recovered as massive U metal of acceptable purity. A semicontinuous reactor for continuous reduction is described. (D.L.C.)

19442 INVESTIGATION ON THE OBTENTION OF URANIUM FROM PIT WATER BY MEANS OF ION EXCHANGERS. H. Ziehr (Bayerische Braunkohlen-Industrie AG. Schwandorf, [Ger.]). Atomkernenergie, 6: 162-4(Apr. 1961). (In German)

While prospecting for uranium in Eastern Bavaria, water samples were collected from sedimentary and igneous rocks containing uranium. Several samples contained more than 1 mg U/l. Water was taken from the lignite deposit Wackersdorf/Bavarian Oberpfalz and from the fluorite deposit Wölsendorf/Bavarian Oberpfalz. Efforts to extract uranium from this water proved successful. Water taken from the fluorite deposits which contain pitchblende was most suitable. This water contains up to 20 mg/l uranium. The content can be increased further by simple leaching of fluorite containing pitchblende. The use of ion exchangers for extracting uranium from water of a fluorite mine near Wölsendorf showed the following two results: (1) Uranium can be concentrated economically even where mining would be profitable and (2) Mine water can be cleaned of radioactive traces. This method of ion exchange opens the possibility of extracting the uranium completely and of getting concentration of 60 to 70% U_3O_8, the costs for work and material being very low. (auth)

19443 PRODUCTION OF URANIUM TETRACHLORIDE. THERMOCHEMICAL STUDIES ON THE REACTION: $UO_2 + C + Cl_2$. Shigeo Hasegawa. Denki Shikensho Ihô, 25: 149-54(1961). (In Japanese)

Results are given of thermochemical studies based on the following reaction: $UO_2 + [x + (y/2)]C + (n/2)Cl_2 = UCl_n + (y/2)CO_2 + xCO$ and $(x/2) + (y/2) = 1$, n = 4,5,6. The values

of ΔC_P, ΔH_T, ΔS_T, and ΔF_T of UCl_4, UCl_5, UCl_6, and UO_2 are calculated at temperatures ranging from 298 to 1405°K. Equilibrium among UCl_4, UCl_5, and UCl_6 formed in the chlorination is based on these data. If the equilibrium of chlorination is considered only with log K calculated from the data, it is shown from the relation between log K and 1/T that the formation of higher chlorides is greater than that of UCl_4 at temperatures of chlorination below 1200°C. (auth)

19444 REMOTE STARTING OF EXOTHERMAL CHEMICAL REACTIONS. M. Delange and H. Huet (to C.E.A.). Belgian Patent 578,102. Priority date, May 2, 1958.

A method is given for starting the reduction of uranium tetrafluoride with calcium in a closed vessel, under vacuum or in an inert atmosphere. A preignited mixture of the reagents and an alkaline or alkaline-earth peroxide, such as Na_2O_2, is projected into the reaction vessel from a rifle-type cartridge fixed on the vessel wall. (EURATOM)

19445 PREPARATION OF URANIUM DIOXIDE. (to N. V. Philips-Eindhoven). Belgian Patent 592,384. Priority date, June 30, 1959.

Ammonium diuranate is submitted, in an oven at a temperature of 800°C, to a flow of 76% nitrogen and 24% hydrogen. This gas mixture is then replaced by pure Ar or N containing some steam but no oxygen. The final product does not absorb any moisture when exposed to air and is ready to be used for sintering operations. (EURATOM)

19446 PURIFICATION OF FLUORIDE SALTS. Warren R. Grimes (to U. S. Atomic Energy Commission). U. S. Patent 2,987,375. June 6, 1961.

This invention relates to methods for purifying metallic fluorides. In accordance with the invention a material consisting essentially of at least one fluoride selected from the group consisting of the alkali metal fluorides, lower uranium fluorides, and zirconium fluorides is purified by melting under an inert atmosphere and successively contacting the molten material with hydrogen or gaseous fluoride and hydrogen. This process effectively removes impurities consisting of H_2O, SO_4^{2-}, $ZrOF_2$, ZrO_2, Ni, Cr, Fe, UO_2, Cl^- and UO_2F_2 from the molten fluoride mass.

Separation Processes

19447 (CF-59-3-94(Rev. 2)(Del.)) EUROCHEMIC ASSISTANCE PROGRAM: COMMENTS BY ICPP, DATED FEBRUARY 25, 1959, ON QUESTIONS LISTED IN ORNL-CF-59-1-75. M. E. Weech (Oak Ridge National Lab., Tenn.). Nov. 16, 1960. 8p.

The handling of interface jettings in waste solution processing and determination of mono-, di-, and tri-butyl phosphates in process solvents are discussed. Decontamination procedures used in ICPP are outlined. Evaporator deentrainment at ICPP is discussed. Information on Lapp pulse units and on continuous dissolution is presented. (D.L.C.)

19448 (CF-60-6-30) EUROCHEMIC ASSISTANCE: COMMENTS BY ICPP ON QUESTIONS FROM EUROCHEMIC. E. M. Shank (Oak Ridge National Lab., Tenn.). June 13, 1960. 4p.

Answers by ICPP personnel to questions asked by Eurochemic are given on a variety of subjects, including off-gas sampling systems, off-gas filtration, iodine evolution during fuel dissolution, and process cell contamination. Data are presented on the % of I^{131} retained in waste solutions in the absence and presence of mercury. (D.L.C.)

19449 (CF-60-11-39) REMOVAL OF RADIOIODINE FROM AIR-STEAM MIXTURES. R. E. Adams and W. E. Browning, Jr. (Oak Ridge National Lab., Tenn.). Nov. 14, 1960. 12p.

The removal of radioiodine vapor from air-stream mixtures such as those from a nuclear incident in a pressurized water reactor was investigated. Activated charcoal traps, simulating part of a commerical charcoal canister, were tested at gas velocities of 23.9 to 74.9 ft/min over the temperature range of 75 to 118°C. The iodine removal efficiency was found to range from 99.80 to 99.94%; it was reduced to 99.54% in a test run with a gas velocity of 290 ft/min at 105°C. (D.L.C.)

19450 (CF-61-5-74) FINAL CYCLE PLUTONIUM RECOVERY BY AMINE EXTRACTION. C. F. Coleman (Oak Ridge National Lab., Tenn.). May 24, 1961. 10p.

The flowsheet visualized from development work thus far for final plutonium recovery and purification will accept as feed a Purex partition stream without feed adjustment beyond the usual reoxidation. Extraction with trilaurylamine at ~0.3M appears suitable for 20 to 60 g Pu/liter product from 0.5 to 2 g Pu/liter feed. Scrubbing with either $\ll 2$ M or $\gg 2$ M HNO_3 is possible. Acetic acid is at present the first choice for stripping agent, with oil-soluble and aqueous-soluble organic reductants as alternates. (auth)

19451 (HW-64754) PROJECT CGC-830 PLANT MODIFICATIONS FOR REPROCESSING NON-PRODUCTION REACTOR FUELS. DESIGN CRITERIA FOR METAL SOLUTION STORAGE. R. F. Duda, W. A. Graf, and G. Kligfield (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 26, 1960. 19p.

Facilities in the 221-U Building for storing the metal solution product of the dissolution step until a reprocessing campaign is scheduled through Redox are described. The storage system tanks will be equipped with high specific gravity alarms to advise of improper incoming solution or self-contamination. Instrumentation, electric circuits, sampling methods, vessels, jumpers, and piping are described. Reference drawings are included. (M.C.G.)

19452 (HW-66781) PLANT MODIFICATIONS FOR REPROCESSING NON-PRODUCTION REACTOR FUELS. DESIGN CRITERIA FOR REDOX PROCESSING OF METAL SOLUTIONS. PROJECT CGC-830. S. R. Bierman and W. A. Graf (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 24, 1960. 14p.

The design criteria for alterations to the Redox facilities that are necessary for nuclear-safe operations when processing NPF materials are outlined. The basic scope requirements for product storage and the criteria for critical mass control when processing NPF solutions in Redox are included. Since NPF solutions contain up to 5% U^{235} or equivalent enrichment, existing Redox equipment is not safe by geometry alone for these solutions. Concentration control will be employed throughout the process as the primary means of avoiding the possibility of a nuclear incident. Neutron monitors and soluble and fixed neutron poisons will be used. To avoid achieving criticality by precipitation, caustic and other precipitating agents will be segregated from the process except for the waste neutralizer. The waste to be neutralized will be analyzed to assure the absence of critical amounts of uranium or plutonium. (M.C.G.)

19453 (IDO-14539) PILOT PLANT STUDIES WITH A SIX-INCH DIAMETER FLUIDIZED BED CALCINER. D. R. Evans (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 20: 1961. Contract AT(10-1)-205. 33p.

The feasibility of the fluidized bed calcination process was demonstrated at the Idaho Chemical Processing Plant.

Solutions simulating wastes from the reprocessing of spent aluminum alloy, stainless steel and zirconium fuels were converted to free-flowing granular solids in a six-inch diameter fluidized bed calciner. The calciner was electrically heated, and a pneumatic atomizing spray nozzle was used to introduce liquid feed into the heated fluidized bed, where calcination took place. Removal of entrained particles from the off gas was achieved through the use of a cyclone and a venturi scrubber, although the cleaning achieved would not be adequate for calcining a radioactive waste. Dry fines removed by the cyclone were returned to the bed with the fluidizing air through an air jet on the dust discharge line of the cyclone. The effects on the calcined product properties and on off gas solids loading of the degree of feed atomization, of bed temperature, and of returning dry fines to the calciner were noted while calcining simulated wastes from aluminum alloy fuels. The distribution of ruthenium and the effect of ammonium ion were determined, and a slurry of a cesium complex with nickel ferrocyanide was dried on sand, then leached, as a method of cesium recovery. (auth)

19454 (LAMS-2518) PURIFICATION OF PLUTONIUM FUELS BY MERCURY PROCESSING. Experimental Survey. D. F. Bowersox and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). Nov. 1960. Contract W-7405-ENG-36. 15p.

The solubilities of selected fission-product elements in mercury indicate that the purification of plutonium fuels by mercury processing is chemically feasible. Such a process was carried out on a ten-gram plutonium scale with samples of two simulated fuels. If rare earth products were used as diluents in fuel, mercury processing resulted in satisfactory purification. If not, a combination with halide slagging was shown to be satisfactory. Yields of 80 to 96% of total plutonium were obtained in the experiments. Iron, cobalt, cerium, lanthanum, niobium, ruthenium, zirconium, and molybdenum were removed to satisfactory levels. Plutonium was obtained as a metallic button by heating a mercury–plutonium solution to 750°C for two hours in a vacuum. (auth)

19455 (NAA-SR-Memo-5869) PYROMETALLURGICAL SEPARATION OF THORIUM FROM Th–Al ALLOYS. D. O. Raleigh (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 14, 1960. 7p.

Thorium was separated from Al–Th alloy by melting the alloy with a moderate excess of zinc and cooling the melt to precipitate thorium zincides. Existing technology indicates that metallic thorium can be recovered from the precipitate by filtering it out of the melt, removing the zinc by vacuum distillation, and melting to consolidate the thorium residue. (auth)

19456 (NAA-SR-Memo-5998) OXIDATIVE DECLADDING OF UO_2 FUEL RODS. I. J. Groce and R. J. Sullivan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 28, 1960. 17p.

Previous research experiments indicated that oxidation of UO_2 to U_3O_8 offered a convenient method of removing UO_2 fuels from the cladding. Further study of this method was conducted in order to increase the removal rate and to demonstrate the applicability of the method to large-scale fuel elements. Utilization of ultrasonic vibrations during oxidation did not appear to give appreciable rate increases over the previous experiments. However, penetration of the cladding at points along the length of the fuel element caused splitting of the cladding as the oxidation proceeded and the fuel was exposed along the full length of the fuel element. Slight agitation then caused the oxidized fuel to drop from the cladding. At temperatures of 400 to 600°C, the time required for decladding seemed to be dependent primarily on the composition of the oxidizing atmosphere. With 1 atm. of pure oxygen at 425°C, a section of fuel element 3 ft long by $\frac{3}{8}$ in. O.D. with 0.010 in. thick stainless steel cladding was declad in 2 hr. This decladding method was also demonstrated on fuel rods of swaged UC powder with 0.010-in.-thick stainless steel cladding. The decladding time was roughly twice that of UO_2 fuel rods. (auth)

19457 (NLCO-826) SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1961–MARCH 31, 1961. R. Burgett, ed. (National Lead Co. of Ohio, Cincinnati). May 5, 1961. Contract AT(30-1)-1156. 72p.

Uranium and TBP Recovery from Waste Solvent. Laboratory and pilot-scale tests were carried out which demonstrated (1) that uranium in waste solvent can be removed by slurrying the solvent with activated charcoal, filtering the slurry, and washing the slurry with water and 3% Na_2CO_3 and (2) that TBP can be recovered from the waste solvent by splitting the solvent with HCl and distilling the TBP-rich phase. Improvement of Green Salt Quality. Denitration of ammonium uranyl trinitrate yielded a light, finely divided form of γ-UO_3 with a surface area higher than that of conventional batch pot powder; however, its reactivity in reduction and hydrofluorination tests was only moderately higher in comparison. Oxidation-reduction cycles were found to increase the reactivity of UO_2 toward hydrofluorination. The properties of various UO_2 samples were determined and correlated with the preparative methods used. Dehydration of Winlo Green Salt. About 27 tons of Winlo green salt was successfully dehydrated to a water content of ~0.04% in a hydrofluorination reactor bank in the Green Salt Plant. Recovery of Uranium from MgF_2 Slag. A process for continuously digesting MgF_2 slag for uranium recovery was successfully tested on a plant scale. In this process, a water slurry of slag is transferred at a fixed rate and reacted with HCl, and the controlled feed rate reduces the hydrogen concentration. Graphite Liner for Bomb Reduction of Green Salt. An evaluation was made on machined graphite as a replacement for jolt-packed MgF_2 presently used to line reduction vessels for uranium metal production. Best results were obtained with a one-piece graphite liner fitted inside a steel vessel with an annulus of MgF_2 between liner and pot. Effects of Feed Material on Ingot Chemical Purity and Yields. The effects of various types of uranium feed stock on the chemical purity and yield of ingots were studied. The following results were obtained: (1) The H content was higher in ingots cast from melts containing more derby material, (2) the O, N, and C contents of samples from ingot tops were significantly lower than those from ingot bottoms, (3) the crude ingot yields were lowest for pigots, briquettes, and heat-shocked grade III derbies, (4) pigots were deleterious to ingot chemical purity, (5) degreased drip crops and dingot extrusion scrap were deleterious to core-to-good-core yield. Alpha Annealing of Uranium. The effect of a high alpha temperature anneal on the structure and growth index of beta heat treated uranium was evaluated. It was found that longer alpha annealing times gave greater recrystallization and that higher temperatures gave more rapid recrystallization. Delays of up to 6 months between beta heat treatment and alpha anneal did not affect either the recrystallization or the growth index. Billet Drilling. A LeBlond-Carlstedt Rapid Borer was tested as a uranium billet drilling machine and found to give satisfactory results, although some tool breakage occurred. (D.L.C.)

19458 (ORNL-2855) LABORATORY DEVELOPMENT OF A TRIBUTYL PHOSPHATE SOLVENT EXTRACTION

PROCESS FOR PROCESSING 20% ENRICHED URANIUM ALLOY FUEL. J. H. Goode and J. R. Flanary (Oak Ridge National Lab., Tenn.). June 1, 1961. Contract W-7405-eng-26. 25p.

A preliminary chemical flowsheet was developed on a laboratory scale for the preparation of feed and two solvent extraction cycles for the processing of Si-containing Al–U alloy, 20% enriched, fuel elements. Major process steps include dissolution of the fuel assembly in Hg-catalyzed nitric acid, removal of silica by coagulation during feed clarification, and recovery of U and Pu by extraction with a tributyl phosphate solvent and selective stripping. Criticality control in existing process equipment is maintained by the use of internal neutron poisons and concentration control throughout the process. (auth)

19459 (ORNL-2992) NEW LABORATORY DEVELOPMENTS IN THE ZIRCEX PROCESS. T. A. Gens and R. L. Jolley (Oak Ridge National Lab., Tenn.). June 2, 1961. 21p. Contract W-7405-eng-26.

A new Zircex flowsheet is proposed in which the nonvolatile products from hydrochlorination of uranium–zirconium alloys are chlorinated with carbon tetrachloride, thereby avoiding the loss of 1 to 6% of the uranium observed in engineering development studies of the older flowsheet for STR fuel in which the hydrochlorination residue was dissolved in nitric acid. Other potential advantages of the new flowsheet include decreased corrosion and elimination of possible explosions between uranium–zirconium alloys and nitric acid. The uranium may be recovered by aqueous dissolution and solvent extraction or by gas-phase fluorination at 200 to 400°C of uranium chlorides. (auth)

19460 (TID-12811) EXTRACTION OF INORGANIC SUBSTANCES BY ORGANIC SOLVENTS. Progress Report, June 1, 1960 –May 31, 1961. Herbert M. Clark (Rensselaer Polytechnic Inst., Troy, N. Y.). May 22, 1961. Contract AT(30-1)-1663. 6p.

An investigation of Ta extraction from aqueous HCl and HF solutions by TBP is reported. Results indicate that the extracting species is mostly $HTaF_6 \cdot 2TBP$. Other work was done on the extraction of iron(III) from aqueous acidic lithium chloride by diethyl ether. The extraction mechanism can be explained by assuming the formation of an etherated hydronium ion as the first step of the extraction process. An observed three-phase phenomenon is ascribed to the formation of large ion-clusters and their condensation into the heavy phase. (J.R.D.)

19461 QUANTITATIVE RADIO PAPER CHROMATOGRAPHY. Francesco Pocchiari and Cesare Rossi (Instituto Superiore di Sanita, Rome). J. Chromatog., 5: 377-94(1961). (In English)

The various techniques utilized in the preparation and measurement of a radio paper chromatogram are reviewed. The scope and application of this technique, which combines paper chromatography and the use of radioactive tracers, have increased considerably due to the fact that the measurement of the activity is performed directly by scanning the paper with an appropriate measuring device, which is now usually entirely automatic. Consequently, a rapid comparison of the activity of the separated substances is possible. (N.W.R.)

19462 THE CHROMATOGRAPHIC SEPARATION OF URANIUM, THORIUM AND RARE EARTHS BY MEANS OF PAPER TREATED WITH A LIQUID ANION EXCHANGER. E. Cerrai and C. Testa (C.I.S.E., Milan). J. Chromatog., 5: 442-51(1961). (In English)

The chromatographic separation of uranium, thorium and rare earths was carried out by using a paper treated with tri-n-octylamine (TNOA). Solutions containing HNO_3, $LiNO_3$, NH_4NO_3, $NaNO_3$, $Ca(NO_3)_2$ and $Al(NO_3)_3$ were used as eluants. This type of chromatographic separation is analogous to ion exchange on anionic resins or with liquid amines. The effects of the various parameters on the R_F values are examined. The separation of thorium, uranium and lanthanum with hydrochloric solutions, on paper treated with tri-n-octyl-phosphine oxide was investigated. The possibility of using columns filled with cellulose powder treated with TNOA, as anionic resin columns is also anticipated. (auth)

19463 EXTRACTION OF RADIOISOTOPES BY BUTYL PHOSPHINIC ACID ETHERS. A. V. Nikolaev, S. M. Shubina, and N. M. Sinitsyn. Radiokhimiya, 2: 1-5(1960). (In Russian)

Extraction of U and Pu fission products by butyl phosphinic acid ethers $(C_4H_9O)_2$ (C_4H_9) PO and (C_4H_9O) $(C_4H_9)_2$ PO with high-boiling hydrocarbon diluent was studied and the distribution coefficient was calculated. The examined solution contained 6% Ru^{106}, 7% Zr^{95}, 2% Cs^{137}, 15% Sr^{90}, and 46% rare earths. The distribution coefficient for extraction with $(C_4H_9O)_2$ (C_4H_9) is almost identical to the K_d obtained for TBP extraction from an identical solution. The difference between the distribution coefficients for extraction with $(C_4H_9O)(C_4H_9)_2$ PO and with TBP is considerable, and increases with increased concentration of extractant in high-boiling hydrocarbons. (R.V.J.)

19464 TEMPERATURE EFFECTS ON URANYL, PLUTONIUM, RUTHENIUM, AND ZIRCONIUM NITRATE EXTRACTION BY TRIBUTYL PHOSPHATE. V. B. Shevchenko and I. A. Fedorov. Radiokhimiya, 2: 6-12(1960). (In Russian)

The distribution coefficient of $UO_2(NO_3)_2$ diminishes with rising temperature. The reaction $UO_2(NO_3)_2 + 2\ TBP \rightleftharpoons UO_2(NO_3)_2 \cdot 2\ TBP$ is exothermic; the direct relation in the coordinate $\lg K_{dw} \rightarrow 1/T$ confirms the reaction dependence on the Van-Hoff equation. The temperature effect in uranyl extraction diminishes as TBP saturation is approached. The distribution coefficient of Pu(IV) increases with temperature from 10 to 40°, after which it drops rapidly. At aqueous solution acidity <0.5N HNO_3 the efficiency of Pu(IV) extraction diminishes with rising temperature. The lowest Zr distribution coefficient is found at 25 to 30°C. The extraction of Ru from nitric acid by TBP at temperatures from 10 to 80° is very poor. (R.V.J.)

19465 TEMPERATURE EFFECT ON NITRIC ACID EXTRACTION BY TRIBUTYL PHOSPHATE. N. M. Adamskii, S. M. Karpacheva, I. N. Mel'nikov, and A. M. Rozen. Radiokhimiya, 2: 13-19(1960). (In Russian)

The distribution of nitric acid between water and 0.736 M TBP in kerosene in the acidity range 0 to 11 mole/l was studied at 23, 40, and 70°C. The apparent constants for nitric acid complexing by TBP are calculated. The dependence of the monosolvate formation constant K_1 on temperature is very slight; at 23, 40, and 70°, K_1 is equal to 0.189 ± 0.029, 0.179 ± 0.021, and 0.174 ± 0.0196; the apparent constant for $(HNO_3)_2 \cdot TBF$ complex formation increases with temperature and at 23, 40, and 70° is equal to $(4.05 \pm 1.1) \times 10^{-4}$; $(5.03 \pm 0.99) \times 10^{-4}$; and $(7.25 \pm 0.23) \times 10^{-4}$, respectively. (R.V.J.)

19466 SEPARATION OF RADIUM AND BARIUM IN EXCHANGE BETWEEN AMALGAM AND SOLUTION. B. P. Konstantinov, B. P. Kiselev, and G. P. Skrebtsov. Radiokhimiya, 2: 44-9(1960). (In Russian)

The coefficient of Ra and Ba separation in amalgam-solution exchange is 52 ± 5. The partition coefficient does not vary with variations in the relative Ra concentration

from 10^{-3} up to 10% or in changes of amalgam and solution. The separation coefficient diminishes with rising temperature, and the density of the exchange current increases linearly with the mixing rate. (R.V.J.)

19467 SEPARATION OF RADIUM FROM BARIUM IN ELECTROLYSIS ON MERCURY CATHODE. B. P. Konstantinov, B. P. Kiselev, and G. P. Skrebtsov. Radiokhimiya, 2: 50-6(1960). (In Russian)

The coefficient for Ra and Ba separation varies from 4 to 35 depending on the current density and electrolyte concentration. The separation coefficient is not affected by radium concentration between 10^{-7} and 10^{-1} wt.%. Theoretical calculations of the effective separation coefficient dependence on current density are in good agreement with the experiment. (R.V.J.)

19468 SEPARATION OF RARE EARTH METALS BY CONTINUOUS ELECTROPHORESIS. V. P. Shvedov and A. V. Stepanov. Radiokhimiya, 2: 65-7(1960). (In Russian)

The ethylenediaminetetraacetic acid (EDTA) is a more efficient complexing medium than citric acid for lanthanide separation by continuous electrophoresis. Conditions for separating $Nd^{147}-Pm^{147}-Eu^{152}-Eu^{154}$ in mixtures were analyzed. (R.V.J.)

19469 SPENT-FUEL PROCESSING. (to Centre d'Etude de l'Energie Nucléaire). Belgian Patent 595,175. Priority date, Sept. 17, 1959.

Uranium metal is first converted into uranium hydride powder. This hydride is then subjected to the action of HCl which produces successively UCl_3, UCl_4, and UCl_6. Each step allows the removal of the chloride of some of the fission products. UCl_6 is finally recovered by vacuum sublimation at low temperature. (EURATOM)

19470 METHOD FOR PURIFYING URANIUM-BASE MATERIAL. (to U. S. Atomic Energy Commission). British Patent 867,057. May 3, 1961.

A process for separating U from Pu is described. The process consists of dissolving in Zn or a Zn–Mg alloy the U-base material at about 800°C, cooling the solution to a temperature slightly above the melting point of Zn, and separating the crystals formed from the supernatant liquid. Mg is added to form a Zn–Mg eutectic with the crystals at about 825°C. The mixture is cooled to slightly above the melting point of the eutectic and the U is precipitated from the solution. The U is recovered by mixing the precipitate with Mg at about 800°C. (N.W.R.)

19471 IMPROVEMENTS IN OR RELATING TO A METHOD OF TESTING FOR URANIUM AND APPARATUS THEREFOR. Harold Mason, James Roland Sanderson, and Tony Mason (to United Kingdom Atomic Energy Authority). British Patent 868,137. May 17, 1961.

A method of testing and production control for uranium and its compounds and the apparatus therefor is described. The method and apparatus for testing an organic solvent for the presence of uranium consists of a liquid-liquid extraction column for washing the solvent with an aqueous solution of a colorimetric agent, ammonium thioglycollate, so as to bring the uranium into the aqueous solution. There consists controls for feeding the solvent and aqueous solution to the column, an absorptiometer having two cells in series, passages connecting the first cell with the aqueous outlet from the liquid-liquid extraction column, and passages for feeding a decolorizing agent, carbon dioxide, to the colored solution after it leaves the first cell and before it enters the second. The organic solvent is washed with EDTA sodium salt to remove thorium before washing with ammonium thioglycollate. (N.W.R.)

19472 SPIRAL CONTACTOR FOR SOLVENT EXTRACTION COLUMN. Carl R. Cooley (to U. S. Atomic Energy Commission). U. S. Patent 2,988,429. June 13, 1961.

The patented extraction apparatus includes a column, perforated plates extending across the column, liquid pulse means connected to the column, and an imperforate spiral ribbon along the length of the column.

19473 ARSENATE CARRIER PRECIPITATION METHOD OF SEPARATING PLUTONIUM FROM NEUTRON IRRADIATED URANIUM AND RADIOACTIVE FISSION PRODUCTS. Stanley G. Thompson, Daniel R. Miller, and Ralph A. James (to U. S. Atomic Energy Commission). U. S. Patent 2,989,367. June 20, 1961.

A process is described for precipitating Pu from an aqueous solution as the arsenate, either per se or on a bismuth arsenate carrier, whereby a separation from uranium and fission products, if present in solution, is accomplished.

19474 CESIUM RECOVERY FROM AQUEOUS SOLUTIONS. Richard A. Schneider (to U. S. Atomic Energy Commission). U. S. Patent 2,989,368. June 20, 1961.

Cesium may be precipitated from an aqueous solution whose acidity ranges between a pH of 1.5 and a molarity of 5 on cobaltous, zinc, cadmium, nickel, or ferrous cobalticyanide. This precipitation brings about a separation from most fission products. Ruthenium which coprecipitates to a great degree can be removed by dissolving in sulfuric acid and boiling the solution in the presence of periodic acid for volatilization; other coprecipitated fission products can then be precipitated from the sulfuric acid solution with a ferric hydroxide carrier.

19475 METHOD OF PREPARING COMPLEXES OF PLUTONIUM WITH DIKETONES. Jonathan S. Dixon, Joseph J. Katz, and Edwin F. Orlemann (to U. S. Atomic Energy Commission). U. S. Patent 2,989,556. June 20, 1961.

A process is described for separating Pu from an aqueous alkaline solution by either precipitating with a β-diketone or extracting into a solution of the β-diketone in an organic water-immiscible solvent. Acetyl acetone and benzoyl acetone are the β-diketones used.

19476 PROCESS FOR SEGREGATING URANIUM FROM PLUTONIUM AND FISSION-PRODUCT CONTAMINATION. C. V. Ellison and T. C. Runion (to U. S. Atomic Energy Commission). U. S. Patent 2,990,240. June 27, 1961.

An aqueous nitric acid solution containing uranium, plutonium, and fission product values is contacted with an organic extractant comprised of a trialkyl phosphate and an organic diluent. The relative amounts of trialkyl phosphate and uranium values are controlled to achieve a concentration of uranium values in the organic extractant of at least 0.35 moles uranium per mole of trialkyl phosphate, thereby preferentially extracting uranium values into the organic extractant.

19477 IMPROVEMENT IN DECONTAMINATION OF AQUEOUS ACIDIC SOLUTIONS CONTAINING PLUTONIUM AND FISSION PRODUCT VALUES BY PROVIDING CEROUS AND/OR MERCURIC IONS THEREIN PRIOR TO A BISMUTH PHOSPHATE CARRIER PRECIPITATION. B. F. Faris and H. K. Strassel (to U. S. Atomic Energy Commission). U. S. Patent 2,990,241. June 27, 1961.

A bismuth phosphate carrier precipitation process is patented for separating plutonium from fission products. Purification of plutonium is accomplished by precipitating bismuth phosphate in the presence of quadrivalent plutonium, thereby carrying plutonium from soluble fission products, and in another step precipitating bismuth phos-

phate in the presence of hexavalent plutonium, thereby carrying insoluble fission products from plutonium. Cerous ions are added to the solution containing Pu^{4+} and mercuric ions are added to the solution containing Pu^{6+} prior to precipitation, thereby enhancing the separation.

19478 EXTRACTION OF HEXAVALENT PLUTONIUM FROM AQUEOUS ACIDIC SOLUTIONS WITH ETHYL SULFIDE. Glenn T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,990,242. June 27, 1961.

A process is described for extracting Pu^{6+} from an aqueous ammonium nitrate-containing nitric acid solution with ethyl sulfide.

19479 ADSORPTION OF PLUTONIUM AND/OR FISSION PRODUCTS FROM AQUEOUS SOLUTION. Roy H. Beaton (to U. S. Atomic Energy Commission). U. S. Patent 2,990,243. June 27, 1961.

A process is patented for separating Pu^{4+} and fission product values contained in an aqueous solution. The aqueous solution is passed over an adsorbent composition consisting of 70 to 100% by weight TiO_2 and ~30% by weight of a binder and recovering the major portion of one of the constituents from the adsorbent and the major portion of the other constituent from the solution. The adsorbent composition is preferably calcined at 800 to 1000°C for not over three hours.

19480 EXTRACTION OF THORIUM AND URANIUM VALUES FROM ACID LEACH LIQUORS. K. B. Brown and D. J. Crouse, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,990,244. June 27, 1961.

A solution containing thorium values may be extracted into an organic phase comprising an organic diluent and a primary or secondary amine. The thorium is stripped from the organic phase by contacting the organic phase with an aqueous phase containing 8 to 9 moles of carbonate per mole of thorium, thereby precipitating thorium values.

19481 METATHESIS OF BISMUTH PHOSPHATE PLUTONIUM CARRIER PRECIPITATE WITH AN ALKALI. Isadore Perlman, Stanley G. Thompson, and Burris B. Cunningham (to U. S. Atomic Energy Commission). U. S. Patent 2,990,245. June 27, 1961.

A process is patented for metathesizing a Pu-carrying bismuth phosphate precipitate to a more easily acid-soluble hydroxide by reaction with a water-soluble carbonate, bicarbonate, or hydroxide in an aqueous medium.

19482 URANIUM RECOVERY FROM METALLIC MASSES. Premo Chiotti (to U. S. Atomic Energy Commission). U. S. Patent 2,990,273. June 27, 1961.

A process is described for separating U^{233} from neutron-irradiated thorium-base metal containing protactinium, zirconium, and rare earth fission products. The thorium metal is reacted with magnesium at from 800 to 900°C whereby a liquid alloy (Mg–Th–fission products) and a solid uranium–protactinium metal form. Molten $ZrCl_2$–KCl–NaCl (or LiCl) is then added to the U–Pa metal at from 450 to 700°C, and a metal phase (nonrare-earth fission products and zinc) is separated from a salt phase ($ThCl_4$, U chloride, Pa chloride, $ZrCl_4$, fission product chlorides). Mg–Zn alloy is then added stepwise to the salt phase for fractional precipitation and separation of the various components, namely (a) a stoichiometric amount for the conversion of Th and Zr to salt-insoluble Th_2Zn_{17} and $ZrZn_{14}$; (b) an about stoichiometric amount for the conversion of the U to U_2Zn_{17}; and (c) a large excess for the precipitation of Pa as a zinc compound.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

19483 (DLCS-1370101) PWR CORE HANDLING EQUIPMENT. CORE I, SEED 1. Section 1. Test Results T-550091-C. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 12p.

The operating characteristics of the Pressurized Water Reactor fuel handling crane were determined; satisfactory performance was obtained for loads from 0 to 1200 lb. Data are presented for the speeds of the trolley, bridge, and tool post; for the minimum incremental movements of the tool post; and for the tool post deflections. (D.L.C.)

19484 (GAT-388) DEVELOPMENT AND PERFORMANCE OF THE PROTOTYPE SEAL FOR THE POWER RECOVERY TURBINE. W. M. Heher (Goodyear Atomic Corp., Portsmouth, Ohio). May 12, 1961. Contract AT-(33-2)-1. 17p.

A double-gland, positive contact seal was developed for use in a power recovery turbine. The seal consisted of two cartridge-type sealing units with carbon faces rubbing against hardened SAE-52100 steel discs. This seal assembly was placed in operation on the turbine in June, 1959, and was removed for inspection in October, 1960, after 12,500 hours of successful operation. The average leak rate during the period of operation was 0.235 pound per day. Examination of the sealing surfaces after removal revealed all parts to be in good condition with less wear having taken place than expected. The seal could have operated successfully for a considerably longer period of time. (auth)

19485 (HW-56146) DEVELOPMENT OF CONTINUOUS CALCINER OFF GAS SCRUBBER. R. Y. Lyon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 31, 1958. 9p.

A gas scrubber was developed to replace the filters used in removing fine particles from the off-gas stream evolved from the continuous calcination of $UO_2(NO_3)_2 \cdot 6H_2O$ used to produce UO_3. The scrubber is a disk and donut type liquid curtain scrubber employing recovered 50% HNO_3 as the scrubbing agent. The operating efficiency of the off-gas system was improved from 62 to 99% with the scrubbers. (D.L.C.)

19486 (HW-57866(Rev.1)) CALIBRATION OF PROCESS VESSELS. C. G. Hough and C. L. Pleasance (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 22, 1960. Contract AT(45-1)-1350. 11p.

Large-scale vessel calibration tests are reported. Calibration equipment and sources of error are discussed. A procedure for calibrating HAPO vessels and an indication of attainable accuracies are presented. (B.O.G.)

19487 (HW-68044) MARK V DISSOLVER INFORMATION MANUAL. H. P. Simonds (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 6, 1961. Contract AT(45-1)-1350. 15p.

The Mark V dissolver was designed to provide a critically safe vessel for dissolving uranium metal of enrichment up to 1% U^{235}. The vessel can be charged with fuel elements up to 10 ft. long and has an off-gas arrangement to eliminate the return of ammonia to the dissolver. In this vessel small charges can be dissolved without using extra chemical. It provides a by-pass routing around the silver reactor during cladding removal. Descriptions are given of the slug distribution cone and column, neutron moderator, fuel crib, sparger, coil assembly, sump, dissolver overflow seal pot, foam breaker, dissolver cover and seal, dissolver air-bleed valve and line, charging rack, and dissolver cover support. (M.C.G.)

19488 (HW-SA-2083) THE DESIGN AND OPERATION OF PUREX PROCESS PULSE COLUMNS. G. L. Richardson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 17, 1961. 50p.

Information on the development of pulse columns for the Purex Process is presented in order to indicate qualitatively the performance attainable with improved cartridge designs, and to show some of the factors involved in scaling up pilot plant results to full plant scale. The pulse columns were designed to produce separated uranium and plutonium products decontaminated by at least a factor of 10^7 from fission products, with average uranium and plutonium losses of less than 0.2% per column and an overall yield of at least 99% of each product. The five types of behavior observed in pulse columns as a function of throughput rate and pulsing conditions are described. The effects of increasing frequency and throughput rate on pulse column efficiency are shown. The different types of perforated plates and packings investigated for Purex service are discussed. Short cuts, indicated by Purex development studies, that may be taken to provide a suitable column design with a minimum of pilot plant development are described. (M.C.G.)

19489 (NAA-SR-Memo-2333) HEATING TRANSFORMER DESIGN PROCEDURE. G. E. Turner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 12, 1957. 28p.

The tables and equations necessary for the design calculations of heating transformers for both magnetic and nonmagnetic pipe loops were compiled and organized. These can be used to determine the amount of heat power required for desired operating conditions, to calculate the pipe current and voltage necessary to produce this amount of heat, and to design a transformer to produce this current and voltage. (M.C.G.)

19490 (NAA-SR-Memo-4754) TECHNICAL DESCRIPTION OF A SODIUM–COMPONENT TEST INSTALLATION. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 2, 1960. 87p.

A Sodium–Component Test Installation designed primarily for operational testing of sodium-heated steam generators and heat exchanges suitable as prototype components for large, sodium-cooled power plants is described. The installation consists of a 35-Mwt gas-fired sodium heat source, a main primary-sodium system, a main secondary-sodium system, a water-steam cycle system, and a cooling tower for heat rejection to air. Design of the main piping and auxiliary systems, system operation and objectives, and safety aspects are discussed. (M.C.G.)

19491 (NAA-SR-Memo-5834) DEVELOPMENT OF AN INEXPENSIVE, REMOTE SAMPLE-TRANSFER DEVICE. C. D. Bingham and D. Janeves (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 3, 1960. 6p.

A simple, low-cost device for remote transfer of radioactive samples in a hot cell or shielded facility was de-

signed and tested under hot-cell conditions. The device consists of a small (7.5 watt) Bodine motor which, by means of a friction drive, extends and retracts a rigi-tape Yo-Yo. The Yo-Yo tape is attached to the cap of a cut-away, 4-oz polyethylene bottle which serves as the sample carriage. The carriage travels inside a flexible, plastic-covered tube called "elephant trunk". (D.L.C.)

19492 (NAA-SR-Memo-5951) STATIC SODIUM TEST OF WESTINGHOUSE FLOW CONTROLLER BEARING. R. Cygan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 8, 1960. 7p.

Tests were carried out to determine the action of a static sodium environment on a special high-temperature ball bearing while operating at the specified speed and loading. The test bearing was operated at 85 rpm and 870 pounds axial load for 385 hr at 1000°F. Visual inspection of the test bearing showed a very marked increase in roughness of both the balls and the ball races. Details of the measurements and a photograph of the bearing parts after test are given. On the basis of this test it did not appear that this bearing will be satisfactory for the service intended. (M.C.G.)

19493 (NAA-SR-Memo-6072) COST REDUCTION OF SCR SODIUM PUMPS. R. W. Atz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 25, 1961. 10p.

A method was sought to reduce the costs of mechanical pumps used for sodium in sodium-cooled reactors. A comparison was made between the free-surface pump purchased for the HNPF test program and a hypothetical unit designed for equal duty, to circulate 7200 gpm of 945°F sodium against a head of 150 ft. The pump produced by this study was the same length as the experimental unit but smaller in diameter. For equivalent performance, it appeared that a cost reduction of 10% may be realized when the pump speed is raised from 1100 to 1700 rpm. (auth)

19494 (NOR-59-384) DYNAMIC TESTING FOR ELASTIC MODULI OF HONEYCOMB CORES. Structures Research Report No. 127. A. S. Benson (Norair. Div. of Northrop Corp., Hawthorne, Calif.). July 1959. 44p.

A simple dynamic test is shown which gives effective core moduli for sandwich structures. A resonant frequency is measured for an elementary dynamic system—a sprung mass. The mass is attached to an electromagnetic shaker by a sandwich specimen which acts as a spring. Modulus is directly related to spring constant which is equal to the product of the mass and the square of the resonant frequency. Good agreement with theory and good reproducibility were found for the flatwise Young's modulus and the principle shear moduli. Accuracies of measurement and calculation are in direct contrast with static test methods. (auth)

19495 (RPE-TN-181) EFFECT OF PROFILE AND LENGTH ON THE EFFICIENCY OF PUMP DIFFUSERS. F. D. Henderson (Gt. Brit. Rocket Propulsion Establishment, Westcott, Bucks, England). Sept. 1959. 31p.

In the application of rocket engines to missiles the limitations of space often impose restrictions upon the dimensions of various components, thus impairing their efficiency. The diffusers of rocket engine pumps are typical components subject to such restrictions and tests were made to determine the form of diffuser combining the shortest axial length with the highest possible efficiency. The most efficient diffuser, regardless of restrictions on axial length, is a right circular conical form having an included angle of about 10°. Restrictions on length are best met by cropping at the outlet, leaving a sharp edge and a sudden enlargement into the delivery pipe. The axial length may be reduced to half the nominal with a loss of only 4% in efficiency. (auth)

19496 (SCTM-103-61(71)) AN ECONOMICAL, LIGHTWEIGHT, FOAMED FIN FOR ROCKET APPLICATION. T. M. Sedgwick (Sandia Corp., Albuquerque, N. Mex.). May 1961. 12p.

A method of constructing a strong, cheap, lightweight fin for single-shot rocket application is described. Test procedures and data are included. (auth)

19497 (SCTM-293-60-52) FEASIBILITY OF AN ELECTRICALLY ACTIVATED MINIATURE SWITCH. R. C. Swyers, A. E. McCarthy, and W. C. Jacoby (Sandia Corp., Albuquerque, N. Mex.). Aug. 30, 1960. 26p.

A feasible switchlike device having a volume of about 10^{-7} cubic inches is described. The device is being developed to support a program intended to evolve a highly microminiaturized electronic system for storage and handling of information. The device is a two-terminal element with two electrically resistive states of about 20 megohms and 150 ohms respectively. A strong electric field is required to close the switch while a relatively high current is required to open it. The device in the closed or low-resistance state handles currents of a few milliamps. Data derived from three experiments are presented and discussed. A possible explanation of operation is offered, problems are mentioned and discussed, and recommendations are made for future work. (auth)

19498 (SCTM-297-58(14)) RESISTORS AND THEIR APPLICATIONS. R. L. Davis (Sandia Corp., Albuquerque, N. Mex.). Aug. 19, 1958. Contract AT-(29-1)-789. 26p.

Resistors and their applications are discussed. A chart of resistor properties for applications is presented along with a summary of developments, and a detailed description of fixed and variable resistors. The chart gives a quick method for selecting resistors for most applications. New developments are summarized to indicate trends in the resistor field. Sections are included which give the properties of each major type and the effects of various environments. (auth)

19499 (TID-4100(1st Rev., Suppl.11)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Office of Technical Information Extension, AEC). Apr. 1961. 111p.

Engineering materials lists are presented which cover computers, hot laboratory equipment, instruments, metallurgical equipment and processes, nuclear radiation instruments, nuclear reactors and facilities, particle accelerators, plant designs and processes (chemical), radiation source units, thermonuclear reaction devices, and waste disposal equipment. (M.C.G.)

19500 (UCRL-5792-T) EFFECT OF CHOICE OF ELECTRICAL CONDUCTOR ON POWER REQUIREMENTS OF LOW TEMPERATURE MAGNETS. Richard G. Mallon (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 13, 1959. 16p.

The relative power requirements are examined for low-temperature magnets of particular shapes and field strengths of 100,000 gauss. Data are given for copper, aluminum, and sodium conductors with reference to temperature. Data indicate that magnets having high purity sodium conductors require the least power at 10°K. It is noted that the power minimums are approximately inversely proportional to refrigerator efficiency, and the temperatures at which the minimums occur are almost independent of refrigerator efficiency. (J.R.D.)

501 (AEC-tr-3971(p.366-72)) A MAGNETIC DE-CE FOR OBTAINING VERY LOW TEMPERATURES. A. Chentsov. Translated from Uspekhi Fiz. Nauk, 61: p. 2, 303-7(1957).

A magnetic cooling device with uninterrupted operation as constructed. This device, in which temperatures below K can be obtained, is based on the considerable thermal fects which accompany the magnetization and demagneti-tion of certain paramagnetic salts at low temperatures. he mechanism of adiabatic demagnetization depends on the crease of disorder of the ions after the removal of the agnetic field which makes itself noticeable by the in-ease of the "magnetic" part of the salt entropy. How-er, since the total entropy of the salt does not change, is increase must be equal to a decrease in the entropy of ermal vibrations of the crystalline lattice of the atoms ich constitute the salt. This means that the intensity of ermal vibrations of the lattice and consequently its tem-rature is reduced. The method of achieving thermosta-lizing conditions at superlow temperatures by construct-g a continuous cyclic mechanism is discussed. (M.C.G.)

502 (CEA-tr-A-900) RÉPARTITION DES CONS-RAINTES ET DES TEMPÉRATURES DANS LES CAIS-ONS DE RÉACTEURS. (Distribution of Strains and Tem-ratures in Reactor Vessels). H. Daldrup. Translated to French by Z. Tilliette from Atomkernenergie, 3: 489-(1958). 15p.

This paper was previously abstracted from the original nguage and appears in NSA, Vol. 13, as abstract no. 5967.

503 (CEA-tr-R-1268) DISPOSITIF POUR LE CON-ROLE DES PRODUITS FINIS BASE SUR LEUR RADIOG-APHIE PAR DES RAYONNEMENTS IONISANTS. (Device r Control of Finished Products Based on Their Radiog-phy with Ionizing Radiation). A. V. Krakovski, Yu. (Iu.) Terman, and Matzkevich. Translated into French by Tarassenko from Russian Patent No. 605 059/25. 1959.

A radiography source arrangement is described in which shielded container is supplied with channels through ich the sources are moved by compressed air. The urces thus move to their use position and return to the ielded container, all controlled from a remote panel. .R.H.)

504 A REMOTE SAMPLING SYSTEM FOR HIGH-EVEL GAMMA SOURCES. R. C. Palmer, D. K. Davis, d W. V. Willis (Georgia Inst. of Tech.; Atlanta). Intern. Appl. Radiation and Isotopes, 10: 128-30(Apr. 1961). n English)

A remote-control mechanism for introducing and re-oving samples from a 12-kc cesium-137 irradiator was signed and built with these primary features: "fail safe" ectrical system, and radiation exposure to operating rsonnel and other experiments in the area. The lift echanism is a solenoid which has a brass extension nned and soldered to the core. Two ferromagnetic leaves e attached to the brass extension and are acted on by the agnetic field of the solenoid. A description of the solenoid included. Also presented is the design and operation of e sample carrier. (N.W.R.)

505 OXIDE RESISTOR FURNACE FOR HIGH-EMPERATURE OPERATION. E. Rothwell (Atomic nergy Research Establishment, Harwell, Berks, Eng.). Sci. Instr., 38: 191-3(May 1961). (AERE-M-711)

A thoria-base oxide resistor furnace is constructed r operation at temperatures up to 2400°C in an oxidiz-g atmosphere. The maximum temperature attainable limited by the ionization of the air in the vicinity of the oxide resistor, and simple means of overcoming this limitation are suggested. The furnace may prove attractive for some specialized investigations, where the requirement of an oxidizing atmosphere is sufficient to override the inherently fragile nature of the resistor element. (auth)

19506 EXPERIENCE IN REPROCESSING ENRICHED REACTOR FUEL ELEMENTS. G. W. Llewelyn and R. H. Allardice (United Kingdom Atomic Energy Authority, Dounreay, Caithness, Scotland). Nuclear Power, 6: No. 62, 71-6(June 1961).

Spent MTR-type fuel elements are reprocessed at Dounreay using a tributyl phosphate countercurrent solvent extraction process. Preparatory operations, such as Al-cladding removal, are carried out in a water tank. A two-cycle process yields uranyl nitrate, with negligible fission product activity and less than 200 ppm impurity content. (T.F.H.)

19507 IMPROVEMENTS TO LEAD CASKETS. P. Germond and P. Victor (to C.E.A.). Belgian Patent 574,515. Priority date, Jan. 21, 1958.

The lid of the casket is reasonably light as it fits into a hollow cylinder. At the bottom of the cylinder is the radioactive substance in its container. Surrounding the container, and inside the hollow cylinder, is a vessel which can be moved up and down the hollow cylinder by means of a lanyard from outside the casket. This motion facilitates the removal of the radioactive substance in its container. (EURATOM)

19508 ARRANGEMENT FOR INTRODUCING ARTICLES INTO A CLOSED CHAMBER AND FOR REMOVING SAME. (to Electricite de France—Service National). British Patent 865,215. Apr. 12, 1961.

An apparatus for introducing rods into and removing them from a nuclear reactor when a pressure differential exists is described. The elevating device for handling articles to be moved into or out of the chamber consists of a cable, one end of which carries a grab adapted to engage the articles, the other end of which is controlled by a winch. (N.W.R.)

19509 IMPROVEMENTS IN WALL MEANS AND IN PANELS FOR USE IN SUCH WALL MEANS AND IN OR RELATING TO NUCLEAR REACTORS. John Neil McAdam Crawford (to Babcock & Wilcox, Ltd.). British Patent 867,825. May 10, 1961.

Walls formed of panels and to panels for biological and thermal shields of nuclear reactors are described. The walls are formed of panels having between adjacent edges sealing members adapted to limit leakage from one side to the other. The sealing is of tongue-and-groove form enabling relative movements of adjacent parts of neighboring panels. Tongue members at each of the junctions, where several panels meet, are extended in overlapping relationship in the region of adjacent corners of neighboring panels to seal the gap at the corners. (N.W.R.)

Heat Transfer and Fluid Flow

19510 (CVNA-77) HYDNA-DIGITAL COMPUTER PROGRAM FOR HYDRODYNAMIC TRANSIENTS IN A PRESSURE TUBE REACTOR OR A CLOSED CHANNEL CORE. H. B. Currin, C. M. Hunin, L. Rivlin, and L. S. Tong (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Feb. 1961. 48p. For Carolinas Virginia Nuclear Power Associates, Inc. Contract [AT(30-1)-2289].

A transient thermal-hydraulic code, HYDNA, was pro-

grammed for the IBM-704 digital computer to calculate the coolant density distribution, to determine the DNB (burnout) point, and to detect the flow instability in a pressure-tube or closed-channel reactor core. The nuclear kinetic equation was not included in the code, but the nuclear transient can be incorporated with the thermal-hydraulic transient by conducting an iterative calculation of coolant density and power density with this code and a nuclear code. (auth)

19511 (NAA-SR-5958) FUGUE. A NONDIMENSIONAL METHOD FOR DIGITAL COMPUTER CALCULATION OF STEADY STATE TEMPERATURE, PRESSURE, AND VOID FRACTION IN PIPE FLOW WITH OR WITHOUT BOILING. R. C. Noyes, F. Bergonzoli, and J. E. Gingrich (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 30, 1961. Contract AT-11-1-GEN-8. 58p.

A method is described for computing steady-state wall- and bulk-fluid temperature, void fraction, and local pressure in liquid-cooled closed channels in which the heating rate is specified. The method was programmed for the IBM 709 and the code, named "FUGUE," is described. In most instances, generally accepted physical relations developed by other investigators are used. The relations are expressed in general, nondimensional form and combined in an internally consistent manner to allow predictions for a variety of coolants and specified operating conditions. Variations in heat-transfer and hydraulic characteristics of the coolant caused by changes in its temperature, pressure, and state are handled by using continuously calculated local values of thermal conductivity, viscosity, density, and quality. Changes are made in the working equations to reflect the sequence of coolant changes from all liquid flow to liquid flow with subcooled boiling to two-phase flow, and finally to all-vapor flow. Computation is done by an iterative procedure using linearized forms of the working equations over short axial segments of the channel to calculate local conditions using assumed parameters. The parameters are then adjusted according to the calculated local conditions and the process is repeated until the correct solution is obtained. Working equations are presented in general form to allow their modification by using modified input data. (auth)

19512 (NAA-SR-Memo-5974) DESCRIPTION OF "SHAFT-1" CODE FOR CALCULATION OF RADIATION SHAPE FACTORS IN FINNED SYSTEMS. R. D. Elliott (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1960. 18p.

A high-speed digital computer program was developed for calculating the shape factors for thermal radiation from finned cylinders to the open sky. The program is to be used in performance analysis of finned radiators for the SNAP 10 Mark I thermoelectric power system. Some results are given along with a print-out of the code. (D.L.C.)

19513 (SC-4591(RR)) ANALYSIS OF PRESSURE DROP AND HEAT TRANSFER OF A PEBBLE-BED-STORAGE HEATER FOR A HYPERSONIC WIND TUNNEL. D. E. Randall and A. Bedford (Sandia Corp., Albuquerque, N. Mex.). May 1961. 33p.

The pressure drop and the time-temperature variation of the air test medium and heat storage material in a pebble-bed heater (designed for intermittent hypersonic wind-tunnel operation at test section Mach numbers of 4 to 11) are presented. (auth)

19514 (SCR-299) AN INDEX OF TABLES AND CHARTS FOR USE IN GAS DYNAMIC STUDIES. D. E. Randall (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 31p.

A list of references is presented which provides tabulated or graphical information regarding the atmosphere, gas flows, flow through shock waves, and information on the thermodynamic and transport properties of gases. 133 references. (auth)

19515 (TID-6881) DESCRIPTION OF INTERMEDIATE HEAT EXCHANGER AND STEAM GENERATOR SELECTIONS. Final Report. R. W. Schroeder and M. A. Chionchio. Feb. 25, 1959. Includes Supplement: MECHANICAL DESIGN BASIS FOR HEAT EXCHANGER COMPONENTS FOR NUCLEAR POWER PLANTS. (Griscom-Russell Co., Massillon, Ohio). Oct. 30, 1958. Contract AT(11-1)-664. 151p.

A discussion is given of the development studies of heat exchangers and steam generators for sodium-cooled reactor systems. Design specifications are included for offset-tube and U-tube intermediate heat exchangers, and involute-tube and offset-tube steam generators with removable bundles. Estimated costs for 70-Mw designs are included. Recommendations for the proposed development program are described. (B.O.G.)

19516 (TID-12687) THE THEORY OF PULSATING FLOW IN CONICAL NOZZLES. Interim Report. Harold G. Elrod, Jr. (Franklin Inst. Labs. for Research and Development, Philadelphia). Feb. 1961. Contract Nonr-2342(00). 29p. (I-A2049-15).

A knowledge of the dynamic characteristics of nozzles and orifices is important in many control and stability analyses of engineering devices. It is usual to assume that the instantaneous flowrate, for a given set of inlet conditions and outlet pressure, is the same as the non-transient value for the same operating conditions. Recently, in connection with the stability analysis of an externally-pressurized thrust bearing, the validity of this assumption was questioned. An analysis is presented to provide an answer. The analysis applies to any fluid, liquid or gas, flowing into a simple conical nozzle. The amplitude and phase of the mass-flux response to a sinusoidally time-variable pressure fluctuation at the nozzle exit are determined. An approximate formula is given for these quantities in terms of the nozzle throat area, the solid angle subtended by the cone, the velocity of the fluid at the nozzle throat, the acoustic velocity at the throat, and the frequency of the pressure fluctuation. (auth)

19517 (AEC-tr-4490) HYDRODYNAMICS AND HEAT TRANSFER DURING BOILING IN HIGH PRESSURE BOILERS. (Translation). M. A. Styrikovich, ed. (Akademiya Nauk S.S.S.R.). 1955. 272p.

Thirteen papers dealing with a series of problems related to the reliability of boiler water tubes are presented. The basic problems discussed are those of the hydrodynamics of a mixture of water and steam and the transfer of heat during boiling in the tubes. The first section of papers deals with the investigation of the flow of gas-liquid mixtures through tubes. The second section contains a discussion of problems on the circulation of steam-water mixtures in boilers. The third section is devoted to heat transfer problems during boiling in tubes. (M.C.G.)

19518 FLOW RESISTANCE AND HEAT TRANSFER IN RING SLOTS WITH ROUGH NUCLEAR TUBES. H. Brauer (Forschungsinstitut der Mannesmann AG, Duisburg, [Ger.]). Atomkernenergie, 6: 152-61(Apr. 1961). (In German)

Pressure drop and heat transfer in annular tubes were measured. The surface of the inner tube was artificially roughened. The investigation covered a range of Reynolds numbers from 200 to 100,000. The maximum heat flux, directed from the inner tube to the fluid, was about 316

w/cm^2 or 2.7 × 10^6 kcal/m^{2}h. The heat transfer medium was water. The hydraulic diameter of the annular tube served as characteristic length in the dimensionless Reynolds and Nusselt number. The results of all experiments are presented in graphical form. Heat transfer and pressure drop increase with the degree of roughness and depend on the type and arrangement of the roughness elements chosen. (auth)

19519 SIMULTANEOUS TRANSFER OF HEAT AND MASS. Jesse Coates and Bernard S. Pressburg (Louisiana State Univ., Baton Rouge). Chem. Eng., 68: 95-8; 100 (May 29, 1961).

Gas-liquid systems in which simultaneous heat and mass transfer processes occur are studied. This type of system includes humidifiers, dehumidifiers, and water coolers. Heat and mass transfer equations are derived for humidifiers and dehumidifiers. It is noted that liquid entrainment, large pressure drops and other mechanical problems must be considered, in addition to the physical aspects of the system. (T.F.H.)

19520 A CORRELATION FOR HEAT TRANSFER IN STRATIFIED TWO-PHASE FLOW WITH VAPORIZATION. P. Sachs and R. A. K. Long (English Electric Co. Ltd., Whetstone, Leicester, Eng.). Intern. J. Heat Mass Transfer, 2: 222-30(Apr. 1961). (In English)

A mechanism of vaporization is suggested for the case in which a saturated fluid flows vertically upwards through a heated annulus. Visual observations and measurements of vapor fraction on an experimental apparatus are recorded, and it is noted particularly that an annulus of vapor was seen to surround a thin liquid layer on the heater surface in the upper regions of the heated system. No nucleate boiling occurred in the liquid layer. The experiment was carried out in the temperature-difference range 18° to 40°F, and the liquid mass flow-rate was varied from 1 to 5 lb per minute. At high heat fluxes in this stratified flow zone it is demonstrated that it may be possible to consider the heat transfer to be entirely convective. A hypothesis is developed analytically, and is substantiated in this experiment by the good correlation of the heat and mass transfer results by means of a standard expression for forced convection. (auth)

19521 HEAT TRANSFER FROM SLOTTED FINNED TUBES. F. Cheers and J. N. Liley (Univ. of Manchester, Eng.). Intern. J. Heat Mass Transfer, 2: 259-61(Apr. 1961). (In English)

It is shown that no marked improvement in the conductance of finned tubes with a fin height/fin spacing of about 3:1 can be obtained by slotting the fins. The tests were made with a bank of tubes in close-pitched staggered formation, mounted in a duct 1 ft square. Measurements of the heat transfer were made for individual tubes with slots up to 3/4-in. wide mounted in central positions in the first and fourth rows of the six-row bank, the rest of the bank being unheated. The conductances measured are graphically presented. (N.W.R.)

19522 BURNOUT IN LIQUID COOLED REACTORS-1. J. G. Collier (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power, 6: No. 62, 61-6 (June 1961).

The problem of fuel element burnout in liquid cooled reactors is studied. The hydrodynamic and heat transfer processes involved in liquid heating are examined in the case in which a cold liquid enters a cylindrical heated tube and emerges as superheated vapor. In each of the heat transfer regions of this tube, processes whereby burnout could occur are analyzed. (T.F.H.)

19523 FERMI AND HALLAM STEAM GENERATORS. Frank Boni and Philip S. Otten (Griscom-Russell Co., Massillon, Ohio). Nucleonics, 19: No. 6, 58-61(June 1961).

Design characteristics of the heat exchangers used in the Fermi Fast Breeder Power Reactor and the Hallam Power Reactor are outlined. Particular attention is devoted to thermal stress reduction and leak handling measures, and the materials used in the steam generators of the two reactors are described. (T.F.H.)

19524 DRAG COEFFICIENTS FOR FUEL-ELEMENT SPACERS. A. N. de Stordeur (BelgoNucleaire S. A., Brussels). Nucleonics, 19: No. 6, 74-6; 78-9(June 1961).

The reactor fuel geometry is considered in which a bundle of fuel pins or rods are separated by spacers, and the coolant flow is parallel to the bundle axis. For this type of geometry, the pressure loss of the coolant across several types of spacers is calculated. Various arrangements of circular wires, lenticular wires, and honeycomb grids, as well as spiral wire wrapping around each pin or rod, are analyzed. (T.F.H.)

19525 X-RAY ABSORPTION MEASUREMENT OF STEAM VOIDS IN WATER AT HIGH PRESSURES. G. E. Martin and E. W. Grohse (Knolls Atomic Power Lab., Schenectady, N. Y.). p.319-34 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

X-ray absorption was applied to the measurement of steam voids in water flowing through electrically heated rectangular stainless steel channels under conditions of pressure, temperature, flow rate, and heat flux corresponding to "local boiling" (subcooled water) as well as "bulk boiling" (saturated water) in the coolant channels of water-cooled nuclear reactors. A balanced dual-beam photometer system is employed. A dual-beam x-ray tube and two scintillation-crystal-photomultiplier-tube detector probes are mounted in a manner permitting remote-operated traversing of the test channel in the horizontal as well as vertical directions. The photomultiplier tubes are used in a difference circuit with one of the tubes monitoring the test channel and the other a remote-operated reference wedge. The difference-measuring connection offers common made rejection so that any differential output is due to a change in attenuation of the test-channel beam. This output is fed through a differential amplifier to a strip-chart recorder. With a test channel consisting of 0.020-in.-thick stainless steel walls, backed by 0.062-in. beryllium windows for strength, void concentrations within a 0.250-in. thickness of water currently can be measured with an absolute accuracy of 2% or better. The test channel is enclosed in a heavy steel housing with windows, permitting void measurements to be made at pressures up to 2000 psia. (auth)

Instrumentation

19526 (AERE-C/R-2297) PULSE POLAROGRAPHY. G. C. Barker and A. W. Gardner (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1958. 26p.

An a-c polarographic technique is described that gives an improved normal polarogram as well as a derivative polarogram. To obtain a normal polarogram the cell voltage is held for most of the time at a fixed value, but at a predetermined time in the life of each drop it is changed by a polarizing pulse for 1/25 sec to a value that gradually becomes more negative as time progresses. Electronic circuits

measure the change in diffusion current produced by each pulse during the second half of the pulse life. The same circuits are used to obtain a derivative polarogram, but in this case small pulses of constant amplitude are used and these pulses are superimposed on a slowly changing voltage. When a normal polarogram is recorded, reversibly and irreversibly reduced ions can be detected at concentrations down to 10^{-7} M, and, as the polarogram is automatically compensated for any diffusion current flowing before the occurrence of a pulse, a minor constituent can be detected in the presence of a major constituent that is reduced at a more positive potential. With the derivative circuit reversibly reduced ions can be detected at concentrations down to 10^{-8} M. (auth)

19527 (AERE-R-3652) A FIELD EMISSION MICROSCOPE FOR ADSORPTION STUDIES. R. J. Hill (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1961. 18p.

Construction and operational details are described for a field emission microscope used in the study of adsorption of water on tungsten. Information required for studies of materials other than tungsten is also reported. (D.L.C.)

19528 (AF-SAM-61-30) VISUAL FLUORESCENT DETECTION BOX. Charles E. Craft (School of Aviation Medicine, Brooks AFB, Tex.). Sept. 8, 1960. 3p.

The design enables the demonstration of fluorescent compounds in a lighted room and also protects the viewer completely from the mutagenic effects of the ultraviolet irradiation. (B.O.G.)

19529 (AFOSR-482) ELECTRON-STREAM KINETIC-POWER SECOND-ORDER TERMS AS OBTAINED FROM MacCOLL'S MEAN VALUES. C. K. Birdsall (California. Univ., Berkeley. Electronics Research Lab.). Mar. 2, 1961. Contract AF49(638)-102. 8p.

The results of MacColl (1960) for traveling-wave-tube circuit voltage and current and for stream density and velocity are discussed and extended to second-order velocity and density values. The dilemma of a change in time-averaged density but none in voltage is discussed. (D.L.C.)

19530 (APEX-564) A-C ION CHAMBER. J. J. Baum (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1960. Decl. No. 28, 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 15p.

A neutron-sensitive ionization chamber that uses variation of the potential of a pair of internal grids to achieve an a-c output was built. This chamber was tested in thermal neutron flux levels from 10^5 to 10^{11} nv and found to be linear to 10^8 nv with a sensitivity of 2.5×10^{-15} amperes rms per unit thermal neutron flux. At higher flux levels the output current was proportional to the 0.6 power of flux. The a-c ion chamber should not replace the common d-c sensor in ordinary applications, but it is intended for use in environments where very high values of insulation resistance cannot be maintained. (auth)

19531 (BNL-5350) A DOUBLE-DELAY-LINE CLIPPED LINEAR AMPLIFIER. R. L. Chase and V. Svelto (Brookhaven National Lab., Upton, N. Y.). 1960. 12p.

A compact transistorized linear amplifier was designed which is suitable for many radiation counting applications. The amplifier delivers symmetrical double-delay-line differentiated output pulses up to ±10 volts in amplitude with a differential nonlinearity of ±1%. It tolerates input signals 400 times full scale without producing spurious output pulses. Both a prompt output and one delayed by 2 μsec are available. The clipping lines and the signal delay line are all terminated at both ends so that physically small, relatively imperfect delay lines can be employed. Five amplifiers occupy only 12¼ inches in a standard 19-inch relay rack. (auth)

19532 (BNL-5390) 100 MEGACYCLE COUNTING SYSTEM. R. Sugarman, W. A. Higinbotham, F. C. Merritt, and A. H. Yonda (Brookhaven National Lab., Upton, N. Y.). [1960]. 25p.

A 100 Mc counting system is described for use with experiments at accelerators. Current switching logic using both transistors and germanium tunnel diodes is used for all high speed logic. All critical circuits have a rise time and time jitter of 2 nanoseconds or less. The logical elements are a pulse height limiter, a discriminator, a multichannel coincidence circuit, a four-fold fanout, and a scale of 8. The fan-out enables a limiter or discriminator output to drive any combination of four elements. Each element is a separate plug-in module. Elements are interconnected with 50 ohm cable at about a 5 ma level with at least one termination. Most module inputs and outputs are compatible so that, for example, a discriminator can either drive or be driven from a coincidence circuit. To insure reliable high speed operation and good time and temperature stability the transistors are operated at unity charge gain either in a current switching mode or in a linear mode in distributed amplifiers. Each tunnel diode provides a switching charge gain of from 2 to 5. Each module was designed for operation up to a continuous counting rate of 100 megapulses per second. Wide variations in random counting rate may be tolerated. (auth)

19533 (BNL-5391) CHARGE COLLECTION IN SEMICONDUCTOR PARTICLE DETECTORS. G. L. Miller (Brookhaven National Lab., Upton, N. Y.) and W. M. Gibson (Bell Telephone Labs., Murray Hill, N. J.). [1961]. 35p.

Semiconductor particle detectors operate as do ion chambers by collection of charge liberated by an incident ionizing particle. However the mechanism of charge collection is much more complicated than in the ion chamber case, depending in detail on the properties of the semiconductor, the potential distribution in the device, and the ionization density along the initial track. Loss of charge can be attributed to recombination of holes and electrons in the dense plasma formed along the particle track or trapping of the moving carriers subsequent to their separation by the electric field. These effects can be distinguished by using particles of widely differing ionization density. Such investigations were carried out for a variety of silicon diodes fabricated in different ways and covering a wide range of resistivities. A correlation between resistivity and collection efficiency and a reduction of collection efficiency for heavily ionizing particles was observed. An analysis was carried out for both trapping and recombination in homogeneous conductivity detectors and surface barrier junction detectors. Dependence of carrier loss on such factors as the resistivity, lifetime, and impurity concentration of the bulk silicon, the ionization density along the particle track and the applied bias were investigated. These results were extended qualitatively to diffused p-n junction detectors which were found to contain gradients in their trapping and recombination properties. (auth)

19534 (CEA-1800) SENSIBILITE DES CHAMBRES D'IONISATION A XENON GAZUEX. (Sensitivity of Gaseous Xenon Ionisation Chambers). Claude Schuhl (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 16p.

The sensitivity of a gaseous xenon ionization chamber

for measuring a low-intensity, high-energy electron or positron beam, or monitoring a gamma beam is studied. An improvement by a factor of 4.5 is shown for the electron range of 5 to 50 Mev. (N.W.R.)

19535 (CNEN-21) SISTEMA DI ELABORAZIONE DI DATI PER IMPIANTI NUCLEARI. (Data Processing System). S. Barabaschi, C. A. Galtieri, E. Lo Prato, and U. Pellegrini (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Dec. 1960. 27p.

A data processing system for nuclear plants is described, which foresees the subdivision of the variables of a nuclear plant in three groups: VARIABLES OF SCRAM include the key variables for the safety of the plant which directly controls the shutdown operation on the plant; VARIABLES OF ALARM include the variables which, although of main use for the reactor operation, do not request such a shutdown as to exclude the operator's decision; and VARIABLES OF INFORMATION include the variables which, although of main use for the reactor operation, supply the necessary data for an improvement of the working conditions. A particular data processing system for nuclear engineering experiments is logically described. Such a system has the following characteristics: 100 channels; scanning rate varying between 1 and 250 p/s; and possibility of predetermining the sequence with which the variables are selected in any manner for groups of 10. (auth)

19536 (CNEN-29) POSSIBILITÀ DI IMPIEGO DI ELEVATORI IDRAULICI (AIR LIFTS) COME POMPE DOSATRICI PER PICCOLE PORTATE. (Possibilities of Use of Air Lift Systems for Deriving Reduced Flows). A. Moccia (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Dec. 1960. 22p.

A simple, non-mechanical device was applied to an air-lift system to derive a reduced flow. The fraction of the total flow can be regulated at will. Factors affecting the constancy and reproducibility of this derived flow were investigated and optimum operating conditions were established in preliminary runs with water and with 45% solution of ammonium nitrate. The possible application of the device for metering radioactive feed solutions into small scale countercurrent extraction equipment is discussed. (auth)

19537 (DLCS-3350101) OPERATIONAL INVESTIGATION OF NUCLEAR INSTRUMENTATION. Test Results T-643725. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 20, 1961. 27p.

A test was run to determine the capability of the nuclear instrumentation system to indicate reactor transient behavior and to test the linearity and alignment of all four channels. The response to a reactivity insertion was found to be linear in the range tested, 5×10^{-11} to 5×10^{-9} amp. Channel A showed the best alignment. (D.L.C.)

19538 (DP-568) HYDROGEN DETECTOR FOR MONITORING URANIUM CLADDING FAILURES. Robert L. Hooker (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1961. Contract AT(07-2)-1. 11p.

A sensitive D_2 detector using thermal conductivity measurements was developed to detect D_2 formed by reaction of U with D_2O and is applicable for monitoring cladding failures in low-flux H_2O- or D_2O-cooled reactors. In detector tests with the Pressurized Subcritical Experiment, it was found that 0.003 mole % D_2 in Ar can be detected and that aluminum corrosion as well as the U-D_2O reaction gave off D_2. (D.L.C.)

19539 (GAMD-2024) A FAILED FUEL ELEMENT LOCATION SYSTEM FOR HTGR. T. G. Dunning (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 16, 1961. Contract AT(04-3)-314. 12p.

The monitor used for the location of failed fuel elements is designed to operate at a minimum coolant activity level of 10% of that for normal operation. This corresponds to a power level of about 33% full load power with no failed fuel elements existing. As the magnitude of a fault increases the coolant activity above normal, the power level required to locate the fault will be reduced to improve the resolution of the system. The system will require about ten hours of reactor operating time to check all coolant channels. If reducing the power level does not cause a more than normal decrease in the activity of the short half-life isotopes, the operating time may be reduced to three or four hours. Depending upon the conditions of the coolant activity, the signal increase for one faulty element may range from 88% to 35 times normal. (auth)

19540 (IEA-40) FERROUS AND CERIC SULPHATE DOSIMETERS: INTERPRETATION OF THE EFFECT OF RADIATION QUALITY. Aron Kuppermann (Sao Paulo. Brazil. Universidade. Instituto de Energia Atomica). 1960. 14p.

The number of ferric and cerous ions produced in ferrous and ceric sulfate dosimeters, per 100 ev of absorbed energy, depends on the quality of radiation used. In a detailed interpretation of this variation of yield with radiation quality, the solution to a diffusion-kinetic equation for a one-radical model was combined with a consideration of the spectrum of local energy dissipation. The mathematical formulation of the one-radical model and the results of calculations for gamma rays, alpha particles, and beta particles are given. The large disagreement with experimental results was considered to be due to the unrealistic model used. (M.C.G.)

19541 (JINR-P-404) AMPLITUDNYE I VREMENNYE KHARAKTERISTIKI IMPUL'SOV STSINTILLYATSIONNYKH SCHETCHIKOV (OBZOR). (Amplitude and Time Characteristics of Scintillation Counter Pulses (Survey)). Yu. K. Akimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 42p.

A review is given on the application and performance of scintillation counters. The particle energy losses in scintillators, conversion and optical efficiencies of scintillators, photoelectron yield, and electron multiplication are analyzed. Fluctuation in photomultiplier pulse amplitude, time characteristics, current shape, and pulse intensity are also considered. The problems of noise, power supply stability, and magnetic field and radiation effects are discussed. 69 references. (R.V.J.)

19542 (LA-2500) AN AUTOMATIC RECORDING LOW-TEMPERATURE DILATOMETER. K. A. Gschneidner, Jr., R. R. McDonald, and R. O. Elliott (Los Alamos Scientific Lab., N. Mex.). Dec. 1960. Contract W-7405-eng-26. 18p.

An automatic recording low-temperature dilatometer is described, and the experimental technique used in making a run is discussed. The specimen temperature is recorded in millivolts by a thermocouple connected to the Y-component of an X-Y strip-chart recorder, while the change in specimen length is simultaneously recorded by a linear variable differential transformer connected to the X-component. (auth)

19543 (LAMS-2491) MODIFICATIONS TO CEC 21-620 MASS SPECTROMETER FOR INCREASED SENSITIVITY. Charles E. Landahl and Roy G. Merryman (Los Alamos Scientific Lab., N. Mex.). Feb. 1960. Contract W-7405-ENG-36. 20p.

The adaptation of a CEC Model 21-620 Mass Spectrometer for studies of trace quantities in discharges from a high temperature furnace is described. This included re-locating preamplifier, additional shielding, minor electronic modifications, vacuum hose replacement, and meticulous cleaning. A proposed "sensitivity to noise" ratio is discussed. (auth)

19544 (NP-10099) DECAYS IN FLIGHT IN A DROP-COUNT CLOUD CHAMBER. (thesis). Technical Report No. 9. Chia-Wei Woo (Washington Univ., St. Louis). Jan. 1961. Contract Nonr-816. 137p.

Analyses were made of observations in the drop-count chamber at 3400 m above sea level. Seventeen cases of Λ^0 decay and 2 cases of K_1^0 decay were identified, with average Q values of 40 and 223 Mev, respectively. The angular distribution of p-emission in 9 cases of $\Lambda^0 \rightarrow p^+ + \pi^-$ showed an 8-to-1 preference in the forward direction, contradicting previous results. It was concluded that no significance need be attached to the apparent anisotopy. Six cases of charged V decays were analyzed. An unusual V event in which one track ended abruptly in the gas of the cloud chamber was analyzed. The large probable errors in ionization measurements made the drop-count-multiplate set-up unsuitable for investigating the angular distribution of π-μ decays. (B.O.G.)

19545 (NP-10169) PLATINUM METAL THERMOCOUPLES. E. D. Zysk (Englehard Industries, Inc., Newark, N. J.). Mar. 27, 1961. 62p.

Presented at the Fourth Symposium on Temperature, its Measurement and Control in Science and Industry, Columbus, Ohio.

A general review of platinum group metal thermocouples is given for the user of noble metal thermocouples. A brief history of noble metal thermocouples is presented and the characteristics of the more commonly used thermocouples are discussed. Preparation for use, constancy of calibration and life, standardization and calibration, care of platinum metal thermocouples, effects of various environments on stability, and radiation effects are discussed. (auth)

19546 (NP-10190) RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 4, November, December [1960] and January [1961]. Hartmut Kallmann (New York Univ., New York). Mar. 1961. Contract DA 36-039 SC-85126. 33p.

In contrast to the linear relation of quenching versus quencher concentration which was previously described, some substances, such as o-terphenyl exhibited a quite different action. A tendency toward saturation was found instead. The results found seemed to fit in with an explanation that o-terphenyl acts both as a quencher and as a substance which can transfer energy. Using a-c impedance measurements, the change in capacitance and the dissipation factor of insulated, photoconducting CdS crystals was investigated. With increasing intensity, the capacitance change reached a saturation value while the dissipation factor went through a maximum. Exactly the same curves were obtained at different bridge frequencies except that the lower frequencies shifted the curves to the lower intensities. These results are in agreement with the theory. The light emission and photoconductivity of two ZnS:Cu and two ZnS:Ag phosphors (in powder form) were determined at room and liquid nitrogen temperature with and without simultaneous infrared. Quenching of fluorescence and photoconductivity due to infrared was found for all four phosphors at both temperatures. The photoconductivity quenching was stronger at low temperature, and the light quenching showed the same behavior except for the ZnS:Cu phosphors with long wavelength infrared. These results and others are discussed in light of the band theory of phosphors. Luminescent and photoconductivity measurements were made on the rise, decay and glow of a ZnS:Ag phosphor excited by x-rays or U.V. at room and liquid nitrogen temperature. The results show that deviations from the predicted theory of a-c photoconductive measurements occur with U.V., but not with x-ray illumination due to the uniform excitation. Glow curves obtained show that the photoconductivity and luminescence do not have the same maximum, even under uniform excitation. (auth)

19547 (NP-10192) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Quarterly Progress Report No. 5, December 16, 1960 through March 15, 1961. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Mar. 15, 1961. Contract DA-36-039 SC-78330. 47p. (CU-3-61 SC-78330-Phys.)

Radioastronomical measurements are in progress at the Naval Research Laboratory using the 10-cm maser amplifier. Further progress is described on the M-band radioastronomy system. Work on the cesium infrared maser and several experiments using a pulsed ruby optical maser are described. A theoretical treatment for dielectric microwave resonators is outlined, along with experimental confirmation. Measurements of dielectric materials of radioastronomical interest, of the OH free radical spectrum, and of several paramagnetic relaxation experiments are described. Beam maser spectroscopy and the "two cavity" maser are described. Population inversion was achieved in the 55 kMc maser experiment. Several atomic hyperfine measurements, including precise experimental results for Kr^{83} are given. Work on the molecular beam-surface interaction experiment is continuing. Values for the spin, magnetic moment and quadrupole moment of Cd^{109} are reported. (auth)

19548 (NP-10200) TEST EQUIPMENT FOR AND EVALUATION OF ELECTROMAGNETIC RADIATION. Quarterly Report for Period December 1, 1960 through January 1, 1961. Report No. 46. J. G. Hewitt, D. E. Rugg, and J. E. Nunnally (Denver. Univ. Denver Research Inst.). Contract N123(60530)10049A. 30p.

Thin film substrate thermocouples are described, and their use in conjunction with an electronic system which gives an overall response to a step function input of heat of one millisecond is discussed. Measurements of thermocouple output of instrumented μk 1 squibs as a function of bridge wire to thermocouple spacing indicated thermocouple output is directly proportional to the square root of the reciprocal of spacing for spacings greater than 0.003 in. For spacings less than 0.003 in. the rate of increase of thermocouple output with respect to the square root of the reciprocal of spacing decreased rapidly. Use of electronic techniques to lower the time response of thin film substrate thermocouples to about one millisecond was demonstrated. Photographs showing both the response of the thermocouple and the response of the thermocouple in its system to a step input of heat were compared. Noise in the system was a serious problem. (auth)

19549 (NYO-9155) DEVELOPMENT OF AN INSTRUMENT AND TECHNIQUE UTILIZING CARBON-14 FOR MEASURING VERY LOW CONCENTRATIONS OF OXYGEN IN HIGH PURITY METALS. Final Report. Roger A. Covert (Alloyd Corp., Cambridge, Mass.). May 1, 1961. Contract AT(30-1)-2335. 37p.

A program to determine the feasibility of measuring oxygen concentrations in metals by utilizing carbon-14 is

described. A modified vacuum fusion system was designed, constructed and operated. Crucibles containing known carbon-14 to total carbon ratios were fabricated for holding the fusion bath. After dropping the unknown into the bath, the evolved gases, containing CO and CO_2, were pumped into a gas fillable proportional counter and their activity determined. Assuming the carbon-14 to total carbon ratio in the unknown was the same as the ratio in the crucibles, simple calculations lead to the percentage of oxygen in the unknown. One type of sample, plain carbon steel containing 20 ppm oxygen, was analyzed and the results of a number of analyses are reported. Although the errors in many of the measurements are large (>10 ppm), it is felt that by making certain modifications in the technique and equipment the approach can be a precise analytical method. (auth)

19550 (NYO-9403) NUCLEAR TRACK IMAGE INTENSIFIER. THIRD QUARTERLY REPORT, DECEMBER 1, 1960 TO FEBRUARY 28, 1961. R. D. DesRochers, H. A. Stern, and L. A. Ezard (Radio Corp. of America. Electron Tube Div., Harrison, N. J.). Mar. 30, 1961. Contract AT(30-1)-2591. 28p.

Design and fabrication techniques were improved so that the large area image intensifier now performs well in image intensifier systems for photographing nuclear tracks. Two successful samples meeting most of the objectives were completed and started in circulation among members of the AEC Image Intensifier Committee for evaluation in systems to record nuclear tracks. Except for a reported long decay in the P-15 phosphor performance was quite good. Resolution, gain, and background requirements were met. Magnification was still high (1/6.5 compared to a design objective of 1/8) but can be lowered to 1/8 by a straightforward mechanical change. Evaporated layers of thallium activated rubidium and cesium iodide were improved and further evaluated. Improved control of color and persistence was obtained. Efficiency as high as 1/3 that of P-11 phosphor was obtained in some samples. The current test series confirmed earlier results that an increase in cesium iodide content shifts the emission spectrum towards the yellow. Burn-resistance and light output was poorer for the cesium enriched phosphors while decay time was decreased. (auth)

19551 (SC-4556(RR)) DEVELOPMENT OF DESIGN CRITERIA FOR RELAYS. Interim Report, November 1 to December 31, 1960. (Oklahoma State Univ., Stillwater. School of Electrical Engineering). Feb. 1961. For Sandia Corp. 76p.

An indication is given of where the design technique developed in the preceding interim report (SC-4530(RR)) fits into the total synthesis problem. Paramaters are discussed which appear in the relations used to describe the relay but do not appear as variables in the relay map. A sample design is included to determine the magnitude of some of the parameters of a two-coil crystal can size relay with a steady-state power at 100 to 150 milliwatts. Aspects of situations resulting from specifications in this design which cannot be satisfied in general by a relay are examined. Design procedures are discussed for classes of relays in which neither the voltage nor power is specified. Design work involving solution of simultaneous equations and physical realizability problems is also discussed and problems encountered with fixed point and unbounded specifications which number more than the theoretical limit are examined. (J.R.D.)

19552 (SCTM-8-61-81) FIVE-POINT READOUT PANEL FOR THERMOCOUPLE VACUUM GAGES. L. E. Klaus (Sandia Corp., Albuquerque, N. Mex.). May 1961. Contract AT-(29-1)-789. 6p.

A multipoint readout panel for thermocouple vacuum gages permits as many as five points to be read in rapid sequence by eliminating the necessity for an individual warmup period for each gage. The panel was commercially manufactured at a unit cost of about $165. (auth)

19553 (SCTM-19-60-81) DEVELOPMENT AND EVALUATION OF AN ELECTRICALLY GENERATED, SHOCK-WAVE PRODUCING TRANSDUCER. Keith H. Banko (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. Contract AT(29-1)-789. 26p.

A transducer for generating highly reproducible mechanical shock waves was investigated with the idea of using the mechanical shocks in the evaluation of crystal accelerometers. A method is developed for experimentally determining the ringing or natural frequencies of crystal accelerometers. Theoretical and experimental work to determine the mechanism by which the mechanical shocks are produced is described. (J.R.D.)

19554 (SCTM-74-61(72)) A METHOD OF CALIBRATING PRESS-EWING LONG-PERIOD SEISMOMETERS. H. J. Plagge and H. G. Laursen (Sandia Corp., Albuquerque, N. Mex.). May 1961. 13p.

A method for calibrating long-period seismometers is described. The calibration of the Lehner-Griffith vertical and horizontal long-period seismometers which are installed in "Frustration" is given. "Frustration" is the seismic tunnel in the Manzano Mountains. (auth)

19555 (SCTM-81-61(24)) IMPROVING TRANSISTOR SWITCHING AT ELEVATED TEMPERATURES WITHOUT THE USE OF REVERSE BIAS. Norman J. Elliott and Albert L. Johnson (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 17p.

Improvement of transistor switching characteristics at elevated temperatures is considered. The results indicate that a switching circuit with passive bias can be made to operate at a temperature considerably higher than one without bias. (D.L.C.)

19556 (SCTM-93-61(24)) ONE-HUNDRED KILOCYCLE TRANSISTORIZED PROGRAMMABLE ELECTRONIC COUNTER-TIMER. James O. Reed (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 24p.

A solid-state, completely programmable, 100-kilocycle frequency meter and counter-timer was developed that is compatible with automatic programming and recording systems such as APAR. The electrical output codes are in binary coded decimal "Excess 3." Power requirement is 5 volts d-c at approximately 250 milliamperes. Packaging is done entirely on $2\frac{1}{4}$- by 3-inch printed circuit boards having 15 pin connectors. (auth)

19557 (SCTM-96-61(73) AN ACCURATE SHOCK CALIBRATOR FOR ACCELEROMETERS. David F. Palmer (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 15p.

A pendulum device using a force transducer is found to be an accurate shock calibrator for accelerometers. Preliminary results indicate that vibration calibration data are valid for shock outputs of Endevco Models 2214, 2224, 2224B and 2225. (auth)

19558 (SCTM-166-59(52) TRANSISTORIZED AUDIO AMPLIFIER, PA-10W-1A. Melvin H. Brock (Sandia Corp., Albuquerque, N. Mex.). May 1960. 10p.

A transistorized audio amplifier which will amplify voice communications from a 500-ohm, 0-dbm, balanced transmission line to a 10-watt level is described. It was de-

signed primarily to drive outdoor loudspeakers. Drawings and circuit descriptions are presented. (M.C.G.)

19559 (SCTM-222A-60(52)) PRELIMINARY REPORT ON A NEW ALUMINUM HUMIDITY ELEMENT. C. M. Stover (Sandia Corp., Albuquerque, N. Mex.). July 1, 1960. Revised Apr. 6, 1961. 15p.

A preliminary report which describes the development and present status of a new Al humidity element is presented. Data are included. (auth)

19560 (TID-7606(p.276-90)) SINGLE-BEAM GAMMA ABSORPTIOMETER. R. W. Stelzner (Oak Ridge National Lab., Tenn.).

A single-beam gamma absorptiometer was developed at Oak Ridge National Laboratory for the continuous analysis of the ions of heavy elements in aqueous flowing streams. The source of 60-kev gamma rays ($\lambda = 0.21$ A) is 10 mg of purified Am^{241} encapsulated in an Al container. The detector is a scanning gamma spectrometer in which a Tl-activated NaI crystal, optically coupled to a multiplier phototube, is used as a radiation transducer. Over the spectral range, continuous scanning rates of 1/10 and 1 cycle/min are available at count rates of up to 2×10^6 photons/min. Calibration curves are obtained by plotting concentration vs the logarithm of the 60-kev photopeak count rate. Linear calibrations were obtained for Pb^{++} in the concentration range of 0 to 300 g/liter, for UO_2^{++} in the range of 0 to 225 g/liter, and for Cd^{++} in the range of 0 to 50 g/liter. The flow rate of the solution in the range of 0 to 200 ml/min does not affect the results. (auth)

19561 (TID-7606(p.311-29)) A CORROSION-RESISTANT PIPETTER FOR REMOTE MEASUREMENT OF RADIOACTIVE SAMPLES. D. J. Fisher, M. T. Keller, and W. L. Belew (Oak Ridge National Lab., Tenn.).

In 1954-55, a remotely-controlled servo-operated pipetter was developed by the Analytical Instrumentation Group for use in the High Radiation Level Analytical Facility at Oak Ridge National Laboratory. In this device, a position servo remotely operates a positive displacement pipet designed so that it may also be cleaned remotely. In the near future, radioactive samples that must be remotely pipetted will contain one or more of the following corrosive chemicals: nitric acid, sulfuric acid, hydrochloric acid, hydrofluoric acid, or aqua regia. This made it necessary to design and install a corrosion-resistant pipet in the standard remotely-operated servo unit of the pipetter in place of the original stainless steel-Teflon pipet. A pipet was designed that is not attacked by any of the above chemicals. It will also quantitatively deliver volumes of solutions made with certain organic solvents. It is possible to quickly substitute these pipets in the servo assembly without varying the correlation between displacement-plunger position and control dial setting. The cost of manufacture of this pipet is estimated to be less than that of the original stainless steel-Teflon pipet. The useful delivery capacity of the pipet is about 700 microliters, but it would be possible to build smaller or larger pipets of this design. The pipet has a contained dynamic seal which can be recompressed if leakage develops due to wear. Extensive seal, precision, corrosion, and life tests of pipets of this new design were made. The precision of delivery of sample volumes was the same as that obtained with the stainless steel-Teflon pipet, 0.2% relative standard deviation. Test results indicate that this pipetter will function reliably for thousands of pipettings of corrosive samples without retightening the dynamic-seal compression caps. (auth)

19562 (TID-12681) FREQUENCY RESPONSE OF A CLIP-ON AMMETER BASED ON THE HALL EFFECT. Progress Report No. 25. Laurence L. Rosier and W. W. Grannemann (New Mexico. Univ., Albuquerque. Engineering Experiment Station). For Sandia Corp., Albuquerque, N. Mex., P. O. 15-8928. Feb. 1961. 12p. (SCDC-2239)

The determination of the frequency response of a clip-on ammeter by use of the Hall effect is discussed. An equivalent circuit of the system was derived and is shown. Methods of improving the frequency response are also discussed. (M.C.G.)

19563 (TID-12715) TEST REPORT AND EVALUATION OF A SILICON DIFFUSED JUNCTION FAST NEUTRON DOSIMETER. W. L. Weiss (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 28, 1961. Contracts AF 33(600)-38062 and AT(11-1)-171. 33p. (XDC-61-2-126).

Data for graphical evaluation of silicon diffused junction fast neutron dosimeters are presented. Shown are data obtained under various testing conditions, particularly designed to show the response of the dosimeter to monoenergetic neutrons, as well as reproducibility and reliability of the device. (auth)

19564 (TID-12788) BERYLLIUM AIR MONITOR. R. E. Kupel (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati), J. T. Rozsa, O. W. Uguccini, and L. E. Zeeb (National Spectrographic Labs., Inc., Cleveland). Apr. 1960. 10p.

A unique mobile direct reading spectrographic laboratory was developed for the continuous sampling of air for beryllium. Both a visual warning and a continuous charting of concentration are provided. Sensitivity is materially below the 0.5 micrograms per cubic liter of air. Results are reported every 72 seconds. (auth)

19565 (TID-12861) MERCURY PYCNOMETER FOR PARTICLE DENSITIES. A. T. Muccigrosso, J. R. Fascia, G. L. Ploetz, and R. E. Mistler (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1961. Contract W-31-109-Eng-52. 7p.

A mercury pycnometer is described which is capable of accurately measuring densities of particles or solid specimens with a volume of less than 0.1 cm^3. A standard specific gravity bottle was used to measure the volume of mercury displaced by porous as well as dense samples. (auth)

19566 (UCRL-6309) A PHOTOELECTRIC-RECORDING RAMAN APPARATUS. Ann Werbin and Thure Anderson (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 14, 1961. Contract W-7405-eng-48. 29p.

A photoelectric Raman apparatus is described. Noteworthy features include the type of monochromator used, the specially designed optical arrangement, and the versatility of the instrument. Samples in the liquid and solid states can be investigated at temperatures ranging from about +150 to −195°C. A number of spectra are given to demonstrate the performance of the instrument. (auth)

19567 (WADD-TN-60-281) A GASEOUS XENON THERMAL NEUTRON DETECTOR. Raymond H. Kelley and Anthony N. Fasano (Wright Air Development Div. Flight and Engineering Test Group, Wright-Patterson AFB, Ohio). Nov. 1960. 14p.

A stable, gaseous-xenon thermal-neutron detector, consisting of a thin U^{235} source sealed in a xenon scintillation chamber and coupled to a photomultiplier tube, was constructed. Characteristics of the device have not changed significantly over an 18-month period. The compact detector, approx 9 in. long and 2 in. in diameter, is especially useful for accurately locating thermal-neutron beams because the detector's sensitive volume is precisely de-

fined, by the U^{235} source. The method of construction, performance characteristics, and potential application of the device are considered. (auth)

19568 (AEC-tr-3971(p.333-65)) NEW INSTRUMENTS AND METHODS OF MEASUREMENT. MECHANO-ELECTRONIC PICKUPS. L. A. Goncharskii. Translated from Uspekhi Fiz. Nauk, 61: No. 2, 277-302(1957).

The successful application of mechanically controlled electro-vacuum devices in laboratories, industry, and clinical practice is discussed. These mechanotrons are used chiefly as highly sensitive mechano-electronic pickups. Tubes with longitudinal control, those with probe control, ion tubes of the glow-discharge type, and ion tubes with pulse discharge are described. The design and operation of the following devices for measurement of mechanical magnitudes are discussed: micrometers, vibrotrons, force gauges, acoustic instruments, and hydromechanical instruments. Thermal and magnetic instruments and mechano-electronic amplifiers and regulators for measuring non-mechanical quantities are described. (M.C.G.)

19569 (AEC-tr-3971(p.588-624)) AN ELECTROSTATIC ELECTRON-VELOCITY ANALYZER. V. I. Milyutin and A. N. Kabanov. Translated from Uspekhi Fiz. Nauk, 61: No. 4, 673-98(1957).

An electrostatic electron-velocity analyzer is described and various diagrams of the instrument presented. The operation of the analyzer is based on the utilization of the strong chromatic action of the outer zone of a single electrostatic lens. The analyzer is a cylindrical electrostatic lens consisting of three electrodes. The middle electrode, with a slit-like aperture, is kept at a high negative voltage, while the other two electrodes are grounded. The terminal screen consists of two parts which can be folded back. The illuminating system is composed of an electron gun and a magnetic condenser focusing the electron beam on the object. The dispersion and resolving power of the analyzer is described. The range of its application and some experimental results obtained with it are reviewed. (M.C.G.)

19570 (CEA-tr-R-1273) MONTAGE A DIFFUSEUR ANNULAIRE POUR L'ETUDE DE LA DIFFUSION DES NEUTRONS DE GRANDE ENERGIE SOUS DES ANGLES FAIBLES. (Annular Scattering Assembly for Study of Diffusion of Neutrons of High Energies at Small Angles). B. M. Golovin, V. P. Dzhelepov, Yu. (Iu.) V. Katyshev, A. D. Konin, and S. (C.) V. Medved. Translated into French from Pribory i Tekh. Ekspt., No. 5, 33-5(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8572.

19571 (CEA-tr-R-1280) SPECTROMETRE A NEUTRONS RAPIDES. (A Fast Neutron Spectrometer). E. A. Zherebin, L. G. Andreev (Andreyev), and D. V. Timoshuk. Translated into French from Pribory i Tekh. Ekspt., No. 5, 29-32(1959). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8571.

19572 (CEA-tr-R-1306) CIRCUITS DE COINCIDENCES EN PHYSIQUE NUCLÉAIRE. (Coincidence Circuits in Nuclear Physics). A. V. Kutsenko. Translated into French from Pribory i Tekh. Ekspt., No. 1, 3-16(1960). 53p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 19168.

19573 (JPRS-9293) USSR WORK ON SEMICONDUCTORS. Translation of Selected Articles from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 5: No. 5, Oct. 1960. 218p.

USSR work on semiconductors is set forth in this translation of selected articles from the Journal of the All-Union Chemical Society. The 10 articles cover the following topics: the chemistry of semiconductors and the electron mechanisms of chemical reactions, organic dyestuff-semiconductors and their photoelectric characteristics, the semiconductor properties of polymer materials, the semiconductor properties of silicides of the transition metals, the chemistry of diamond-like semiconductors, chemical reactions on the surface of germanium and silicon and their electronic analogs, vitreous semiconductors, physicochemical analysis of semiconductors, radioactivation analysis of pure materials and prospects of its development, and physicochemical problems of dielectrics. A separate abstract was prepared of one of the articles. (M.C.G.)

19574 (SCL-T-364) AKUSTISCHE MESSGERÄTE. (Acoustical Measuring Instruments). Th. Schwirzer. Translated by Marcel I. Weinreich (Sandia Corp.) from Z. Instrumentenk., 67: 223-31(Sept. 1959). 22p.

A comprehensive survey is presented on the most important acoustic measuring instruments commercially available in West Germany. Characteristic data are compiled and critically compared to enable the nonspecialist to choose the most suitable apparatus for a certain field of application. (D.L.C.)

19575 (UCRL-Trans-664(L)) LAMINATED SCINTILLATION DETECTOR FOR THE REGISTRATION OF FAST NEUTRONS IN THE PRESENCE OF γ-QUANTA. V. S. Evseev, V. I. Komarov, V. Z. Kush, V. S. Roganov, V. A. Chernogorova, and M. M. Shimchak (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). Translation of report JINR-P-470. 1960. 23p.

A laminated detector which is highly efficient in registering neutrons and is insensitive to gamma radiation is described. The detector, intended for registration of neutrons in the energy interval from 5 to 20 Mev, consists of 28 disks of a plastic scintillator, 80 mm. in diameter and 4 mm. thick. Adjoining disks were separated from each other with black paper. There was no optical contact of the paper with the disks. The electronics and basic characteristics of the detector are discussed. (M.C.G.)

19576 SOME CHARACTERISTICS OF A STRONTIUM-90 BETA-PARTICLE DETECTOR FOR GAS-LIQUID CHROMATOGRAPHY. Frank T. Upham, Frank T. Lindgren, and Alex V. Nichols (Univ. of California, Berkeley). Anal. Chem., 33: 845-9(June 1961). (UNRL-9039)

Characteristic and performance data are given for an apparatus employing a beta-particle ionization detector. Details regarding the detector geometry, the injection assembly, and calibration data are presented. Application is made in the gas-liquid chromatography of methyl esters of long-chain fatty acids. (auth)

19577 A THREE CRYSTAL PAIR SPECTROMETER. L. Ask, B. Erlandsson, B. Persson, and K. Valli (Univ. of Lund, Sweden). Arkiv Fysik, 19: 21-32(1961). (In English)

The construction of a scintillation pair spectrometer of high efficiency and good energy resolution is described. Its response function for energies below 18 Mev is obtained and the variation of this response, due to different collimations of incident radiation and the use of central crystals of different lengths, is studied. (auth)

19578 INSTRUMENTATION AT CALDER HALL AND CHAPELCROSS. Atom, No. 54, 7-9(Apr. 1961).

Instruments for detecting power output, temperature, neutron flux, control rod positions, coolant flow and leaks, and fuel element failures are provided for all Calder Hall

reactors. These instruments, as well as the reactor safety systems, are outlined. In addition, Chapelcross reactor, number 4, contains further instrumentation for concrete studies, pressure vessel strain measurements, graphite and dome temperature monitoring, and fuel element testing facilities. (T.F.H.)

19579 INSTRUMENTS IN THE FAST REACTOR. Atom, No. 54, 10-11(Apr. 1961).

Nuclear instrumentation for the Dounreay fast reactor is described. Methods for measuring the fast neutron flux, the liquid metal coolant flow, the inlet and outlet temperatures, and the coolant oxide content are outlined. (T.F.H.)

19580 ELECTRONIC PROBLEMS OF REACTOR INSTRUMENTATION. J. Weill. Atomwirtschaft, 6: 217-25 (Apr. 1961). (In German)

The present state and the development tendencies in electronics for reactor monitoring and control are presented in individual papers on neutron detectors, constituent elements of reactor instrumentation, reactivity measurements, temperature measurements, safety systems, and analog computers. By transistorization, standard construction elements, and automatic operational control, improvements in reliability, durability, and stability are obtained. (auth)

19581 DETERMINATION OF THE SENSITIVITY OF THE ILFORD G_0 AND G_2 EMULSIONS. Max Morand, Simone Desprez-Rebaud, and Michel Betrencourt. Compt. rend., 252: 2212-13(Apr. 10, 1961). (In French)

The sensitivity of the Ilford G_0 emulsion is 3200 ev, that of the G_2 emulsions is 1500 ev. The "residual granulation-path" theoretical curve is in perfect agreement with the experimentally observed values. (tr-auth)

19582 GAS-FILLED ULTRAVIOLET DETECTOR WARNS OF FIRES AND EXPLOSIONS. D. H. Howling and R. C. Roxberry (McGraw-Edison Co., West Orange, N. J.). Electronics, 34: No. 21, 52-5(May 26, 1961).

A detector tube that exhibits a power gain of 110 db enables rapid counting of ultraviolet radiation in many applications including fire and explosion detection. The tube features a stable high-power gain and sensitivity in the spectral region of 1900 to 2900 A and exhibits a peak response at 2200 A. It consists of two symmetrical electrodes of special construction and material enclosed in a gas-filled uv-transmitting glass envelope. Electrode symmetry permits operation on a-c or d-c. The electrodes interchange as anode and cathode on alternate half-cycles using a-c. Because of the natural gas-discharge quenching aspects of the a-c supply, the full gain inherent in gas amplification devices is made available as power gain. (N.W.R.)

19583 A BETA-GAMMA IONIZATION CHAMBER FOR SUBSTANDARDS OF RADIOACTIVITY. I. USES AND CALIBRATION. J. W. G. Dale, W. E. Perry, and R. F. Pulfer (National Physical Lab., Teddington; Middx.; Eng.). Intern. J. Appl. Radiation and Isotopes, 10: 65-71(Apr. 1961). (In English)

Information on the construction, characteristics, and calibration of the type 1383A chamber is given. This instrument is a combination of a re-entrant cylinder (well-type) gamma-ray chamber with an approximately "2π" beta-ray chamber which in conjunction with a d-c amplifier or electrometer, is suitable for the measurement of samples of γ-emitting and β-emitting isotopes. The γ and β ionization currents and the background are of the order of 10^{-11}, 10^{-10}, and 10^{-14} amp/mc, respectively. The calibration figures for standard Na^{24}, P^{32}, K^{42}, Fe^{59}, Co^{60}, Br^{82}, Y^{90}, Au^{198}, and Ra^{226} sources and the correction factors applicable to measurements of solutions in 2 and 5 ml ampoules, and 10 ml bottles are given. (auth)

19584 A BETA-GAMMA IONIZATION CHAMBER FOR SUBSTANDARDS OF RADIOACTIVITY. II. INSTRUMENT RESPONSE TO GAMMA RADIATION. J. W. G. Dale (National Physical Lab., Teddington, Middx., Eng.). Intern. J. Appl. Radiation and Isotopes, 10: 72-8(Apr. 1961). (In English)

A method of calculating the response to gamma radiation of the Type 1383A chamber for those isotopes whose gamma energies lie within the range 0.2 to 3.0 Mev is described. The instrument response is expressed as current per millicurie for each isotope. An allowance is made for the effect on response, especially at lower energies, of the materials with which the instrument is constructed. Estimates of current per millicurie produced by this method are shown by subsequent experimental calibrations to lie, with few exceptions, within ±3% of the experimental values. Activity estimates may therefore be made with reasonable precision where no absolute method (such as 4π proportional counting) is available or a very short half life precludes its use. (auth)

19585 STATISTICAL ERRORS IN DISINTEGRATION RATE MEASUREMENTS BY THE COINCIDENCE TECHNIQUE. P. J. Campion and J. G. V. Taylor (Atomic Energy of Canada Ltd., Chalk River, Ont.). Intern. J. Appl. Radiation and Isotopes, 10: 131-3(Apr. 1961). (In English)

A simplified expression is developed for the fractional standard deviation as a function of the efficiencies of both detectors where the efficiency of one of the detectors can be made nearly equal to unity. The deviation is applicable to any form of the coincidence technique; however the case of 4π beta-gamma coincidence counting is considered. For simplicity, backgrounds and accidental coincidences are neglected. Their effects are usually small and can be calculated in the conventional manner. (N.W.R.)

19586 DIMENSIONING OF RADIATION RELAYS AND OF LIMITING VALUE SWITCHES OPERATING WITH ISOTOPES. G. Sahner (VEB Vakutronik, Dresden). Isotopentechnik, 1: No. 4, 107-9(Mar. 1961). (In German)

The dimensioning of the connection of a radiation relay and the effects to be taken into consideration are detailed for the various operating systems, and the results obtained presented in such a way that such a relay can be adapted reasonably to any measuring problem. The allowance for the statistical stray of the integration voltage calls for some overdimensioning of the connection. Such a relay may be rated so that the danger of incorrect function caused by statistical variations becomes smaller than the danger of failure of an electronic element. The data stated in leaflets, especially the maximum attainable accuracy of measurement, can be accepted with certain qualifications only. Since standard definitions of these parameters are not yet available, the present report is well suited as a proposal for establishing these definitions. The results obtained, however, may also be applied to other appliances. Instruments operating with the use of radioactive isotopes have to record the exceeding of a limiting value. (auth)

19587 DESIGN FOR A THREE-CIRCLE X-RAY GONIOMETER. R. W. H. Small and S. Travers (The University, Birmingham, Eng.). J. Sci. Instr., 38: 205-6(May 1961).

Using the scheme first described by Furnas and Harker, for the collection of three-dimensional intensity data from a single crystal in which the motion of the counter tube is restricted to a horizontal plane, a comparatively simple instrument is designed. Particular attention is given to the

design of simple bearings which are free from backlash and wear, and which permit the recording of diffracted beams up to an angle of 2θ of 165°. The instrument has provision for scanning and recording integrated intensities over an arc of 4°. Some details of performance are given. (auth)

19588 A NOVEL TYPE OF DETECTOR IN NUCLEAR SPECTROMETRY. Marie Skrivankova-Vesela (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 79-84(1961). (In Czech.)

Three types of semiconducting detectors of p-n transistors are dealt with. Their properties are described and the possibility of their use in nuclear spectrometry is indicated. (auth)

19589 THE USE OF VIBRATIONS IN THE INVESTIGATION OF ISOTOPE ADSORPTION. Jaromir Bar and Pavel Polansky (Antonina Zapotockeho Military Academy, Brno). Jaderná energie, 7: 90-2(1961). (In Czech.)

The comparison of kinetic curves of the adsorption of Pr^{143} isotope in aqueous acetate buffer solution (pH = 6.3; $\mu = 0.012$) on rubber and polyamide (silon) foil, filter paper and on wool textile in various conditions of the experiment indicated the possibility of the use of vibrations (100 cycles/sec) with the amplitude ~0.1 mm for mixing of radioactive solutions containing samples of sorbents in the investigation of isotope adsorption from liquid phase to solid sorbents. These vibrations influence the time needed for the adsorption in a similar way as flutter mixing and mechanical damage of filter paper and textile does not occur. (auth)

19590 EXTERIOR QUENCHING OF GEIGER MÜLLER COUNTERS. Ivan Lehraus and Premysl Mokry (Physics Inst., Czechoslovak Academy of Sciences, Prague). Jaderna energie, 7: 93-5(1961). (In Czech.)

The lifetime of argon-alcohol filled GM tubes, measured in total output counts, is significantly influenced by the presence of an exterior quenching circuit. In cosmic ray monitoring, these GM tubes must be very stable over a time span of the order of ten years. The stability is directly related to the lifetime. GM tubes operating without an external quenching circuit are reported to have a lifetime of about half that of GM tubes directly coupled to a slow monostable quenching circuit and pulse shaper. The slow quenching circuit is compared to a fast monostable circuit capacitatively coupled to the GM tubes. The fast circuit yields a deadtime of 200 to 300 microseconds and a lifetime for the GM counting tubes that is about 10 times greater than with the slow quenching circuit. The latter yields a deadtime of about 1.5 milliseconds. Finally, lifetime studies were made in a configuration that coupled a variable number of GM tubes to a single fast-quenching circuit. The long lifetime is preserved for banks of 1, 2, 6, and 12 counters, but a slow, monotonic decrease in lifetime with increase in number of counters in the bank is observed. (TTT)

19591 BETA SPECTROMETERS. Hans-Henning Hennies (Universität, Gottingen, Ger.). Kerntechnik, 3: 145-51(Apr. 1961). (In German)

Various instruments used for measuring β particle energy spectra are described. This type of spectrum can be obtained with magnetic, electrostatic, or scintillation spectrometers. The physical principles of the individual spectrometer types are explained, and the special properties of each type are discussed with respect to the requirements of β spectroscopy. (tr-auth)

19592 MEASUREMENT OF THE BACK-SCATTERED RADIATION AS A MEANS FOR THE IDENTIFICATION OF BETA PARTICLES. H. Fessler, H. Kiefer, and R. Maushart (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 3: 151-3(Apr. 1961). (In German)

A type of activity measurement apparatus which permits the simultaneous measurement of the primary and back-scattered radiation of a β emitter is described. In addition to the activity, the β energy of an emitter is determinable because of the energy dependence of the back-scattered radiation constituents. Some applications are the rapid identification of unknown β emitters, the measurement of the ratio of two known β emitters in a mixture (for example, $Sr^{89}-Sr^{90}$), and the testing of the degree of purity of individual β emitters. (tr-auth)

19593 A NEW TYPE OF ENGINEERING METHOD FOR THE CONTINUOUS RADIATION MONITORING OF WATER AND WASTE WATER. L. Weise. Kerntechnik, 3: 164-7 (Apr. 1961). (In German)

A new method for continuous water monitoring is reported, and a recently developed monitor is described. (tr-auth)

19594 A SIMPLE RADIATION MEASUREMENT AND ALARM APPARATUS. K. Diebner (Schiffsingenieurschule, Flensburg, Ger.) and H. Völcker. Kerntechnik, 3: 175-7 (Apr. 1961). (In German)

The development of transistor circuits has made possible the manufacture of portable electrical devices. Especially in the construction of radiation detection instruments have the commercial miniature d-c converters found use. In connection with miniature counters these converters permit the production of real pocket apparatus. Such an apparatus with especially simple construction is described. It permits the measurement of radiation intensity over at least two decades with low cost and minimum energy needs. The expansion of the measurement range is discussed. (tr-auth)

19595 FUNCTION AND OPERATION OF THE PULSE CHANNELS IN THE START-UP OF A REACTOR. F. H. Rinn. Kerntechnik, 3: 179-81; 184-5(Apr. 1961). (In German)

The design and operation of a log N channel for neutron flux measurements during reactor start-up is explained. (J.S.R.)

19596 MEASURING TECHNIQUES FOR ENERGY LOSS STUDIES OF 2.8 MeV BETATRON ELECTRONS IN MATTER. Torbjörn Westermark (Royal Inst. of Tech., Stockholm). Nuclear Instr. & Methods, 10: 169-84(Mar. 1961). (In English)

Methods for accurate recording of energy loss spectra for electrons at a few Mev are discussed. An electrostatic method is described. The method selected involves the variation of a portion of the current of the spectrometer magnet and recording of the spectrum with an XY-recorder. Some experiences with Hall generators for steering the X-axis are given. The record includes the primary line as well as two or three energy loss spectra. One of the latter is due to a standard absorber. Problems are discussed including evaluation of energy loss properties. (auth)

19597 EFFECT OF SOURCE THICKNESS ON THE MEASURED SHAPE OF BETA SPECTRA. D. Fehrentz and H. Daniel (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Nuclear Instr. & Methods, 10: 185-8(Mar. 1961). (In German)

The effect of the source thickness on the measured shape of the P^{32} beta spectrum is investigated with a double-lens beta spectrometer. Two methods are used: the source is

covered with aluminum films of various thickness, or sources of various thickness are prepared by evaporation in vacuo. The thickness of the aluminum films is varied between 0.27 and 10 mg/cm^2 while the thickness of the evaporated sources is varied between 0.01 and 10 mg/cm^2. For the shape factor determination the maximum energy determined with the source under investigation is taken. It is found that a source thickness of 1 mg/cm^2 changes the shape factor by about 2% per mc^2. The coefficient for the energy dependence of the undistorted shape factor is $a = (-4.2 \pm 1.0) \times 10^{-2}/mc^2$; the quoted error is three times the standard deviation. (auth)

19598 A FAST SCALER FOR PULSED ACCELERATORS. F. Lacoste and J. Leiss (Ecole Normale Superieure, Orsay, France). Nuclear Instr. & Methods, 10: 189-92(Mar. 1961). (In English)

A fast scaler using the principle of adding standardized pulses with a diode integrating circuit is built and tested for experiments conducted with a pulsed linear accelerator. With this scaler, it is possible to count an average of one event per machine pulse of duration 10^{-6} sec, with a counting loss smaller than 1%. The resolution time of the scaler is approximately 10^{-8} sec. (auth)

19599 DETECTION OF HIGH ENERGY γ-RAYS BY PLASTIC PHOSPHORS. L. Keszthelyi, I. Berkes, I. Demeter, and I. Fodor (Central Research Inst. of Physics, Budapest). Nuclear Instr. & Methods, 10: 193-201(Mar. 1961). (In English)

Pulse height distributions of 3 to 20 Mev γ rays in a 3 in. × 3 in. NaI(Tl) crystal and in an 8-cm diameter × 16-cm long plastic phosphor are compared. It is found that for measuring high energy γ rays in some cases plastic phosphors can be used instead of NaI(Tl) crystals. (auth)

19600 FAST AMPLITUDE DISCRIMINATOR. A. Sarazin, J. Samueli, and G. Bougnot (Institut d'Etudes Nucleaires, Algiers). Nuclear Instr. & Methods, 10: 202-4 (Mar. 1961). (In French)

A fast amplitude discriminator is described. The threshold bias is adjustable from 1 to 30 volts. The positive output pulse has a standard amplitude (1.5 volt) and length (200 nanosec). The difference of the lecture between pulses of 100 and 2 nanosec width is of the order of 1 db. (auth)

19601 DETERMINATION OF K^+-MESONS IN A SECONDARY BEAM OF SATURNE. J. Seguinot (Faculte des Sciences, Caen, France), J. Teiger, and L. Van Rossum. Nuclear Instr. & Methods, 10: 205-11(Mar. 1961). (In French)

The electronic device for determination of the number of K^+ mesons produced in a secondary beam of the "Saturne" proton synchrotron is described. The selective criteria and the tests for identification of the K^+ mesons are analyzed in detail. For $\pi^+/K^+ = 400$, at 600 Mev/c, less than 5% of the detected particles correspond to spurious event. (auth)

19602 PHOTONS FROM POSITRON BEAMS IN THE GeV RANGE. D. M. Binnie (Univ. of Manchester, Eng.). Nuclear Instr. & Methods, 10: 212-16(Mar. 1961). (In English)

High energy positrons in liquid hydrogen produce, in addition to bremsstrahlung, pairs of quanta by annihilation with atomic electrons. Separation of the annihilation and bremsstrahlung radiation should be obtained at a small angle to the positron beam. This appears to offer a method of producing Bev photons relatively free from bremsstrahlung. The technique could be especially applicable to bubble chamber investigations of strange particle and other photoproduction reactions. (auth)

19603 ORANGE-SECTOR POSITRON MONOCHROMATOR. C. Schuhl and C. Tzara (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Instr. & Methods, 10: 217-23(Mar. 1961). (In French)

An 'orange-sector' monochromator of positrons is described. The paths of the positrons and the shape of the magnets are calculated. This monochromator is calculated to obtain monochromatic photons by annihilation in flight of the positrons. The experimental results are in good agreement with the calculus. (auth)

19604 A HIGH GAIN IMAGE INTENSIFIER SYSTEM WITH FAST SHUTTER ACTION FOR APPLICATION IN HIGH ENERGY PHYSICS. G. Goetze and H. Kanter (Westinghouse Research Labs., Pittsburgh). Nuclear Instr. & Methods, 10: 224-8(Mar. 1961). (In English)

A high speed camera system employing two transmission secondary electron intensifiers in tandem is described. This camera is capable of recording the light emission of single photoelectrons on photographic film. Possible applications of this instrument in high energy physics are discussed. (auth)

19605 A TUNNEL DIODE UNIVIBRATOR AND PULSE HEIGHT DISCRIMINATOR. Y. Hazoni (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Instr. & Methods, 10: 231-3(Mar. 1961). (In English)

A univibrator and a pulse height discriminator using tunnel diodes and backward diodes are described, along with their applications in pulse shaping and fast coincidence technique. The main advantages achieved are simplicity of design and speed. The characteristics of the two diodes are shown. (auth)

19606 DIRECT CURRENT STABILIZATION OF SCINTILLATION COUNTERS USED WITH PULSED ACCELERATORS. F. P. G. Valckx (Rijksuniversiteit, Utrecht). Nuclear Instr. & Methods, 10: 234-8(Mar. 1961). (In English)

A simple system is described for the gain stabilization of the photomultiplier of a scintillation counter. Use is made of a constant light source. The stabilization factor of the system is 200. (auth)

19607 AN IMPROVED CIRCUIT FOR PULSE SHAPE DISCRIMINATION BETWEEN NEUTRONS AND GAMMA RAYS. J. Rethmeier, H. J. Boersma, and C. C. Jonker (Vrije Universiteit, Amsterdam). Nuclear Instr. & Methods, 10: 240-2(Mar. 1961). (In English)

Electronic devices are described for discriminating between neutrons and γ rays. Neutrons incident upon a stilbene scintillator cause recoil protons, and γ rays cause electron showers; the device is capable of discriminating, by pulse shape methods, between 0.8 to 14 Mev protons (or α particles) and electrons above 200 kev. Pulse height spectra are given, with and without n-γ discrimination, for a combined Co^{60}-Po source, a Hg^{203} source, and a 14-Mev neutron source. (T.F.H.)

19608 TIME-TO-PULSE-HEIGHT CONVERTER AS COINCIDENCE AND ANTI-COINCIDENCE INDICATOR. L. Cranberg (Los Alamos Scientific Lab., N. Mex.). Nuclear Instr. & Methods, 10: 243-4(Mar. 1961). (In English)

It is noted that the time-to-pulse-height converter may be advantageously used as a coincidence or anticoincidence counter. The time resolution is dependent only upon the duration of the "start" gate. Further, the converter makes possible the analysis of the time spectrum of accidentals, in cases, for which, the bona-fide source is pulsed or modulated. The use of the converter as an anticoincidence

detector is also shown. In this use the pulse heights determine the nature of the events. (T.F.H.)

19609 DOUBLE SCATTERING EXPERIMENTS WITH AZIMUTH ANGLE INTEGRATION. Joachim Kessler (Technische Hochschule, Karlsruhe, Ger.). Nuclear Instr. & Methods, 10: 245-6(Mar. 1961). (In German)

In order to count more particles in double scattering experiments, an integration may be carried out over the azimuthal angle. By this procedure, however, the left-right asymmetry is often greatly diminished. An arrangement is proposed, which makes possible integration over the full range 0 to 2π of the azimuthal angle without losing asymmetry. (auth)

19610 MICROWAVES IN NEW DETECTOR MEASURE THERMAL-NEUTRON FLUX. Price D. Wickersham and Lydick T. Ostwald (Ramo-Wooldridge, Denver). Nucleonics, 19: No. 6, 66, 68-71(June 1961).

A device for measuring thermal neutron fluxes is described. The neutrons ionize gas molecules that are contained in a nonresonant microwave waveguide, and the resulting phase shift and attenuation of the microwaves indicates the flux. Calculated and observed values for the flux are compared. The detector is quite insensitive to temperature changes, and responds very rapidly to flux changes. A gas purity on the order of 99.9%, however, is necessary for efficient operation. (T.F.H.)

19611 DOSIMETRIC INVESTIGATIONS OF IONIZATION CHAMBERS FOR SOFT X-RAY IRRADIATION. A. V. Frolova, A. N. Krongauz, Z. I. Shul'gina, and V. G. Bobylev (Ministry of Health, RSFSR). Vestnik Rentgenol. i Radiol., 36: No. 1, 49-54(Jan.-Feb. 1961). (In Russian)

An absolute and relative method of measurement was used to determine the qualitative characteristics of the soft x-ray irradiation (12 to 60 kv). An air ionization chamber was employed in the absolute method. All conditions for the x-ray reproduction were provided in this chamber. The relative method involved the use of apparatuses with diaphragmatic and wall chambers. Results of investigations of various materials used for the blinds of diaphragmatic and the walls of thimble chambers are given. It was found that for practical purposes, the most convenient are diaphragmatic chambers with blinds of beryllium and wall chambers made of caprolactam and terelene, with the wall 0.1 mm thick. These are recommended in manufacturing the RM-1m apparatus. (auth)

19612 COSMIC RAYS, RADIOACTIVITY OF MATERIALS AND SHIELDING. Charles E. Roos (Vanderbilt Univ., Nashville). p.51-60 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The contribution of cosmic radiation and natural radioactivity from structural and shielding materials to background radiation of the environment are discussed. The need is stressed for careful shielding of a γ spectrometer used for low-level counting. (C.H.)

19613 PHOTOTUBES, RESOLUTION AND MULTICHANNEL ANALYZERS FOR HUMAN WHOLE BODY COUNTING. Raymond L. Weiland (Vanderbilt Univ., Nashville). p.61-74 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The importance is stressed of the choice of scintillation phosphors, phototubes, and hardware used in the construction of γ spectrometers for use in human whole-body counting. The relative merits are discussed of using a single large crystal, several smaller crystals arranged in an array around the subject, or many large crystals arranged on the surface of a sphere surrounding the subject. The crystal-phototube assembly used with the Vanderbilt Medical School whole-body γ detector is described in detail. Problems encountered in the operation of several phototubes with a single crystal, and the use of a 256-channel analyzer of the memory-core type are discussed. (C.H.)

19614 SENSITIVITY OF SCINTILLATION SCANNERS. Charles E. Miller (Argonne National Lab., Ill.). p.75-83 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The use and design features of scintillation scanning equipment for low-level total-body counters are discussed. The counting efficiency of a 3×5 in. NaI(Tl) crystal is considered. It is pointed out that the best delineation is obtained by using a focussing-type collimator. Very valuable data can be obtained with scintillation scanners, but these measurements are time consuming. (C.H.)

19615 COMPUTER ANALYSIS OF GAMMA RAY SPECTRA. Howard L. Rolf (Vanderbilt Univ., Nashville). p.109-16 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Methods are described for processing the output of a 256-channel analyzer on an IBM-650 computer. Applications in the operation of a γ spectrometer for whole-body counting are discussed. (C.H.)

19616 CONTINUOUS MEASUREMENT OF THE RADIOACTIVITY OF SUBSTANCES CONTAINED IN A LIQUID. (to Landis & Gyr S. A.). Belgian Patent 584,284. Priority date, Dec. 3, 1958.

The amount of the radioactive substances being very small, the liquid has to be concentrated in order to increase the precision of the measurements. A known quantity of the liquid is dropped onto a heated absorbing strip which moves continuously so that the liquid is vaporized when the impregnated spot comes within range of the detector. The device can easily be entirely automatic. (EURATOM)

19617 DOSE RATE METERING OF IONIZING RADIATIONS. (to M.B.L.E.). Belgian Patent 585,708. June 15, 1960.

Belgian Patent No. 582692 of Sept. 15, 1959, is improved. In order to ensure a practically linear response at different energy levels of the incident radiations, particularly when the energy level is below 0.5 Mev, an opaque absorbing casing is fitted around the device. The device itself consists of a layer of thermoluminescent substance deposited on a thin metal strip positioned close to a hot wire. The whole assembly is sealed inside a glass tube. (EURATOM)

19618 IMPROVEMENTS IN OR RELATING TO NUCLEAR PARTICLE DISCRIMINATORS. Richard Bruce Owen (to United Kingdom Atomic Energy Authority). British Patent 866,950. May 3, 1961.

A scintillation particle discriminator is described. A dynode of the phototube is operable at a potential difference between it and the next subsequent electrode sufficiently small to produce space-charge limitation of the current leaving the dynode. The discriminator has means for deriving an output pulse from the dynode, and amplitude discriminating means for accepting output pulses above a given amplitude. The dynode described is the last dynode; the next subsequent electrode being the anode. (N.W.R.)

19619 IMPROVEMENTS IN OR RELATING TO ELECTRODES FOR ELECTRICAL CONDUCTIVITY CELLS. John William Hill and Stanley Alexander Dean (to United Kingdom Atomic Energy Authority). British Patent 866,957. May 3, 1961.

An electrode for a conductivity cell is described. The electrode consists of a rod having an insulating sheath and

a connected electrode tip. The tip protrudes through an insulating cap which engages the sheath so as to clamp the tip between the cup and the sheath. (N.W.R.)

19620 LINEAR SELSYN OR SYNCHRO-TRANSMITTER. Albert Hirsch (to U. S. Atomic Energy Commission). U. S. Patent 2,988,697. June 13, 1961.

An apparatus is patented for determining the position of a member movable axially within a closed tube without perforating the tube. A magnetic core, short with respect to the length of the member, is mounted thereto. A coil and a plurality of windings are disposed axially outside the tube and have a total uniform circumferential progression of 360 mechanical degrees or a multiple thereof relative to each other as they extend the length of tube. The coil and windings are electrically excited whereby axial movement of the magnetic core induces therein voltages having magnitudes or phase angles proportional to the axial position of the magnetic core within the closed tube. Detecting means are provided for reading the magnitudes or phase angles of these voltages and hence the position of the movable member within the closed tube.

Materials Testing

19621 (NAA-SR-Memo-5230) CYLINDRICAL SHELLS UNDER AXIALLY SYMMETRICAL THERMAL AND MECHANICAL LOADINGS. C. O. Peinado (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 16, 1961. 14p.

The problem of a cylindrical shell with an axially symmetrical thermal and mechanical loading is treated using equations which include the effect of transverse shear deformation. This allows extension of the thin wall theory into the region of the "thin-thick" cylinders. The solution for an edge loaded long cylinder was developed and applied to the cases of a cylinder with an edge displacement discontinuity and a cylinder with an edge rotation discontinuity. It is shown that at the recognized limit of the thin wall theory, the maximum stress is reduced 9% and 7% respectively for the cases described above. (auth)

19622 (RM-2686(AEC)) STATIC DEFORMATION OF A PLASTIC MEDIUM. Jon Mathews (RAND Corp., Santa Monica, Calif.). Jan. 18, 1961. Contract AT(11-1)-135. 26p.

Static solutions are presented for the displacement and stresses in a plastic medium surrounding a spherical cavity in which a hydrostatic pressure exists. Various cases are considered, including the case in which the pressure "unloads" the plasticity caused by the formation of the cavity. Some numerical examples are included. (auth)

19623 (TID-7600) PROCEEDINGS OF THE SYMPOSIUM ON NONDESTRUCTIVE TESTING TRENDS IN THE AEC REACTOR PROGRAM. Held at Atomic Energy Commission Headquarters Building, Germantown, Maryland, May 20, 1960. (Division of Reactor Development, AEC). Mar. 1961. 91p.

Five papers and associated group discussions are included which were presented at the Symposium. The topics covered include testing specifications, radiation techniques, ultrasonic techniques, electromagnetic techniques, etc. Separate abstracts have been prepared for each of the papers. (D.L.C.)

19624 (TID-7600(p.3-10)) GENERAL STATUS OF TESTING SPECIFICATIONS. W. J. McGonnagle (Argonne National Lab., Ill.).

The history of nondestructive testing in the AEC program and some trends in such testing are discussed. The objectives and reasons for AEC testing specifications are given, and AEC efforts to achieve these objectives are briefly described. Some of the pitfalls of writing specifications are discussed. A few specifications are considered as examples: ultrasonic testing of tubes, radiographic cleanliness, x-ray or fluoroscopic testing of fuel elements, and uranium distribution in alloys. It is emphasized that every reactor is different and, consequently, specifications should be tailored to the reactor. The unsatisfactory aspects of present-day nondestructive testing are discussed. (D.L.C.)

19625 (TID-7600(p.11-19)) RADIATION TECHNIQUES. Grover M. Taylor (Los Alamos Scientific Lab., N. Mex.).

Methods for using radiation for nondestructive testing in the AEC reactor program and problems to which they have been applied are described: conventional radiography, autoradiography, microradiography, fluoroscopy, radiation gauging, x-ray fluorescence analysis, electron radiography, gamma radiation counting, gamma spectrometry, and electron microscopy. A group discussion is included. (D.L.C.)

19626 (TID-7600(p.20-54)) ULTRASONIC TECHNIQUES. Robert W. McClung (Oak Ridge National Lab., Tenn.).

Recent ultrasonic methods of nondestructive testing used in the AEC reactor program are discussed in detail. The merits of each of the three types of ultrasonic techniques are considered: reflection, through transmission, and resonance. Various methods of velocity and elastic constants determination are outlined, and measurement of longitudinal and shear-wave velocities are discussed. Such methods are applied to inspect uranium fuel element cores to determine whether they had sufficient beta heat treatment. Measurement of the ultrasonic attenuation provides information on the metallurgical structure of the sample, e.g., grain size. The behavior of ultrasound in thin metal sections is discussed, particularly with reference to Lamb wave propagation. Several ultrasonic methods now being used to detect and evaluate nonbonds in clad materials in clad materials are described for clad capsules, rings, hollow slugs, and flat fuel plates. Ultrasonics is also used to measure thicknesses, and methods and equipment for remote ultrasonic inspection of irradiation fuel elements are described. A group discussion is presented in which the following topics are treated: (1) studies of bond properties using Lamb waves, (2) weld inspection, (3) ultrasonic inspection of graphite, (4) contact and immersion techniques, (5) notch standards produced by spark discharge machining, and (6) availability of notch standards. (D.L.C.)

19627 (TID-7600(p.55-64)) LEAK, THERMAL, AND SURFACE TEST METHODS. Paul D. Edwards (Los Alamos Scientific Lab., N. Mex.).

Leak, thermal, and surface testing are described briefly, and some trends in those modes of testing in the nuclear energy field are outlined. Some of the items discussed are helium leak detection, frost test, thermosensitive phosphors, liquid surface tension changes with temperature changes, infrared emission from surfaces, visual inspection, penetrant testing, etc. A group discussion is presented in which penetrant testing terminology and standards, specification difficulties, recording of minor defects, and criteria for selecting leak tests are treated in detail. (D.L.C.)

19628 (TID-7600(p.65-80)) ELECTROMAGNETIC TESTING OF REACTOR COMPONENTS. J. D. Ross (Du Pont de Nemours (E. I.) & Co. [Savannah River Lab.], Aiken, S. C.).

Some of the work done at different AEC sites on electromagnetic testing of reactor components is reviewed. Electromagnetic testing is suitable for inspection of tubing, and various methods are described: impedance analysis, frequency detection, and a method for testing installed tubing. Impedance analysis using a tuned probe can be used to test coextruded uranium elements with Zircaloy cladding. Problems associated with cladding and penetration testing are discussed. Equipment for measuring the thickness of the nickel layer between uranium and aluminum interfaces in some fuel elements are described. The future possibilities of equipment design are discussed. A group discussion is presented on both electromagnetic testing and other topics covered in the symposium. (D.L.C.)

19629 (TID-12759) CYCLIC PRESSURE TESTS OF LARGE SIZE PRESSURE VESSELS. Progress Report No. 28. M. M. Lemcoe (Southwest Research Inst., San Antonio). Mar. 15, 1961. Contract AT(30-1)-2140. 41p.

Static testing of Vessel No. 3 was completed. Results are tabulated and discussed. Results of the completed tests on Vessel No. 4 are also discussed. Stress concentration factors determined in the static analysis, effects of strain redistribution upon initial cycling, and results of plastic fatigue tests are to be correlated with related studies at other research facilities. (J.R.D.)

19630 ELECTROPOLISHING TECHNIQUES FOR THE PREPARATION OF ZIRCONIUM AND ZIRCALOY-2 SPECIMENS FOR TRANSMISSION ELECTRON MICROSCOPY. J. L. Whitton (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Sci. Instr., 38: 222-3(May 1961).

A method for electropolishing zirconium and Zircaloy-2 thin foils for transmission electron microscopy is described. The foil, 1 in. × $\frac{3}{8}$ in. × 0.001 to 0.003 in., insulated around the edges with polystyrene in trichloroethylene, is mounted in a spring clip as the anode. The cathodes are mounted separately from the anode and can be moved vertically without altering the position of one cathode relative to the other. The electropolishing is accomplished by making a small hole at the bottom and at the top of the foil with the cathodes near the foil. Then the cathodes are brought to the center of the foil and moved about 1 cm apart and polishing is continued until the holes enlarge and meet. This takes about one to three minutes depending on the thickness of the foil. (N.W.R.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

19631 (AE-36) GEOCHEMICAL PROSPECTING OF A URANIFEROUS BOG DEPOSIT AT MASUGNSBYN, NORTHERN SWEDEN. Gösta Armands (Aktiebolaget Atomenergi, Stockholm). 1961. 48p.

In connection with prospecting for uranium ores in northern Sweden, a peat bog, situated 4.5 km NW of Masugnsbyn, Norrbotten, Sweden and showing a remarkable content of uranium, was discovered. Closer investigation of several samples of the peat indicated that the comparatively high content of uranium and radon was connected with the occurrence of radioactive springs in the region. It was found that four different kinds of water were responsible for the supply of radioactive material to the peat, viz: ground water, surface water, spring water, and ground water emanating from fractured rock. The spring water—probably a mixture of ground water and water from the fractured rock—contains uranium to the extent of micrograms per liter. The pH is about 7. The uranium content of the water system deriving from the fractured rock is about 200 to 300 micrograms per liter. The maximum radon content is about 3000 emans. The pH is >7 and the specific conductivity about 150×10^{-6} ohm^{-1} · cm^{-1}. The radioactive peat is characterized by extremely low gamma radioactivity which may be due to the recent emplacement of uranium by spring waters. It is suggested that the peat in question has served as a "collector" for uranium, rare earth metals etc., since the pH condition—pH about 7—was favorable to the settling of these elements. The uranium enrichment seems to be due to a transport of Na, Mg, and Ca bicarbonates emanating from dolomite deposits or pegmatitic granite dikes in the vicinity of the peat, the bicarbonate waters serving as carriers of the uranium. (auth)

19632 (EFINS-61-14) HYDROSTATIC PROPERTIES OF AN IONIZED ATMOSPHERE. E. N. Parker (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Feb. 1961. Contract AF18(600)-666. 17p. (AFOSR-404)

It is shown that the electrostatic field in an ionized atmosphere causes ions of different charge and mass to concentrate at different levels. Thus, if the solar corona is sufficiently quiet as to permit an approach to equilibrium, its composition is stratified and not typical of the true solar composition. In the presence of sufficient stirring to maintain chemical homogeneity, it is shown that the settling of helium ions through the hydrogen corona toward their lower equilibrium level is a powerful heating mechanism. It is shown that the ionized atmosphere of a hypothetical helium star will eject protons into space with a velocity of the order of gravitational escape velocities and kilovolt energies. (auth)

19633 (HW-67799) MEETING OF UNITED STATES ATOMIC ENERGY COMMISSION METEOROLOGY PROGRAM LEADERS. J. J. Fuquay, P. W. Nickola, and R. J. Engelmann, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 20, 21, and 22, 1960. Contract AT(45-1)-1350. 37p.

Included are summaries, only, of the seventeen papers presented at the meeting. The meteorology programs of the Atomic Energy Commission and other government agencies were discussed. (C.W.H.)

19634 (IA-586) RADON AND RADIUM CONTENT OF SOME ISRAELI WATER SOURCES AND A HYPOTHESIS OF UNDERGROUND RESERVOIRS OF BRINES, OILS AND GASES IN THE RIFT VALLEY. Emanuel Mazor (Israel. Atomic Energy Establishment, Rehovoth). Jan. 1961. 37p.

In a survey of the radon and radium content of various water sources in Israel, a number of anomalies were detected. All the highest values found were in waters located in the Jordan Rift Valley, which is a part of the large Syrian—African Rift Valley. To explain the anomalies and other geochemical features of the sources, a hypothesis of underground reservoirs of brines, oils, and gases was developed. Field data appear to indicate the existence of such reservoirs in the Dead Sea and Lake Kinneret areas, where they seem to be the source of the mineral and radioactive springs occurring on the shores. The results lead to some practical conclusions concerning the possible exploitation of potassium-rich brines found near the Dead Sea, the salinization of Lake Kinneret, and prospecting for oil and gas in the Rift Valley. (auth)

19635 (NP-10189) THEORETICAL ASPECTS OF ROCK BEHAVIOR UNDER STRESS. Poulter Laboratories Technical Report 002-61. E. F. Poncelet (Stanford Research Inst. Poulter Labs., Menlo Park, Calif.). Mar. 3, 1961. 20p.

Derivations were made of the intensity of the deviator stresses and of cohesive strength and cohesive rigidity for bodies composed of individual atoms from first principles. The tensile strength is expressed as a limiting principal stress above which fracture occurs, while the yield strength is expressed as a limiting skew stress above which flow takes place. With these considerations in mind the phenomena of crushing of rocks and of blasting in bore holes are described. (auth)

19636 (NYO-7949) AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY, AND PALEOBOTANY OF URANIUM-BEARING LIGNITES. Analyses of Lignite Samples. Thomas F. Bates and Robert L. O'Neil (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Mar. 1, 1960. Contract AT(30-1)2000. 52p.

Data from analyses of 669 lignite, clay, and carbonaceous samples from North and South Dakota, California, Utah, and New Mexico are presented. The geographic location and geologic age of the samples are given. Uranium was determined by fluorimetric methods and iron by x-ray fluorescence measurements. Chemical determinations were made of C, H_2O, Ash, S, Al, Ca, Mg, Si, P, Na, and K. The trace elements were determined by emission spectroscopy. Equivalent uranium was determined by counting a half-gram sample of ashed lignite for 10 min. on a scintillation counter. (M.C.G.)

19637 (TID-12517) FISSION PRODUCTS IN THE LOWER STRATOSPHERE. P. B. Storebo and S. C. Stern (General Mills, Inc., Minneapolis). Apr. 1, 1961. 18p.

Samples containing radioactive particulates were obtained at 50,000, 65,000, 80,000, and 90,000 ft during 1956 to 1960. Using fission product ratios calculated in these samples, and analyses of air masses in the lower stratosphere, a preliminary study was performed of bomb debris admixture which is initially injected into tropical and polar stratospheric air masses. Results of this study are presented along with results of a comparison between fission product ratios in tropospheric and lower stratospheric fall-out for part of 1959. (J.R.D.)

19638 (UCRL-6282) PERMANENT DEFORMATIONS. FINAL REPORT. PROJECT COWBOY. William A. Hamilton, Robert B. Petrie, Claude P. Benedix, and Lynden B. Ballou (California. Univ., Livermore. Law-

ence Radiation Lab.). Mar. 9, 1961. Contract W-7405-ng-48. 62p.

The measuring techniques used to determine deformation within the halite medium in and adjacent to the Project Cowboy zero stations are described, and the results are given. (D.L.C.)

19639 (UCRL-6445) EXCAVATION OF CONTAINED TNT EXPLOSIONS IN TUFF. Nicholas M. Short (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 18, 1961. Contract W-7405-eng-48. 25p.

The effects of two contained H. E. explosions in volcanic tuff were examined by mining directly into the explosion sites. One explosion (516 lb of TNT) increased its initial shot chamber volume of about 9 cu ft by a factor of about 5 and produced in addition some 126 cu ft of broken rock. Around this explosion, only natural joints in one direction were filled with carbon to a maximum distance of 42 ft, and no new fractures in other directions were developed. The other explosion (973 lb of TNT) expanded its 17 cu ft chamber to 10 times this initial volume and led to rock breakage, mostly by subsequent roof collapse, of 345 cu ft. Because this shot vented on firing, very little of the carbon-carrying gases entered joints, and fractures caused by the explosion are almost absent. The features characteristic of these two explosions were compared to an earlier 1000-lb explosion in salt in which, by contrast, numerous radial carbon-filled cracks were produced, and the less expanded chambers survived without collapse. For the explosions in tuff it was concluded that joints exercised a primary role in locating the surfaces of fracture failure, early venting inhibits development of carbon-marked fractures, and the medium undergoes greater expansion and more readily collapses after the shot than does salt. (auth)

19640 (UCRL-13000) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature March 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Mar. 31, 1961. 31p. For California. Univ., Livermore. Lawrence Radiation Lab.

A partially annotated bibliography is presented consisting of 126 references to current literature on the physical properties of rocks, rock mechanics, wave propagation, and related subjects found in January, February, and March 1961, issues of journals and indexes. The references are arranged alphabetically by author and source. (B.O.G.)

19641 (UCRL-13002) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature, April 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Apr. 28, 1961. 36p. For California. Univ., Livermore. Lawrence Radiation Lab.

19642 (CEA-tr-R-1314) PROBLEME DE LA CONTAMINATION RADIOACTIVE DES OCEANS ET DES ORGANISMES MARINS. (The Problem of Radioactive Contamination of Oceans and Marine Organisms). E. M. Kreps. Translated into French from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., 321-34(1959). 42p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 16693.

19643 URANO-ORGANIC MINERAL ASSOCIATION. A. M. Abdel-Gawad and Paul F. Kerr (Columbia Univ., New York). Am. Mineralogist, 46: 402-19(Mar.-Apr. 1961).

Semi-fluid asphalt which percolates through uranium ore bodies on the San Rafael Swell is indurated by heat at temperatures from 250°C to 300°C. The indurated material becomes brittle and generally similar in physical properties to naturally indurated "asphaltite." Infrared curves of artificially indurated material also compare favorably with curves for natural "asphaltite." Infrared curves for both indurated artificial and natural "asphaltite" show weak and indistinct absorption bands in contrast to the stronger absorption of semi-fluid asphalt. Mineralogical investigation of the uranium silicate coffinite indicates that the mineral is similar to the synthetic coffinite, prepared by Fuchs and Hoekstra (1959), through the absence of an essential hydroxyl component. The intimate and widespread association of indurated uranium-bearing "asphaltite" and the uranium silicate coffinite suggests that the two were formed contemporaneously. The urano-organic constituent could presumably have been hardened by irradiation, although this seems unlikely. However, such an origin is hardly even conceivable for the uranium silicate coffinite. Hydrothermal origin is believed to prevail both for the coffinite and the associated uranium "asphaltite." (auth)

19644 THE AIR CONTENT OF SMALL AND LARGE RADIOACTIVE IONS. Jean Bricard, Jacques Pradel, and André Renoux (Centre d'Études Nucléaires, Fontenay-aux-Roses, France and Faculté des Sciences, Paris). Compt. rend., 252: 2119-21(Apr. 5, 1961). (In French)

By an application to RaA atoms from the decay of atmospheric radon, the relationships valid for small ordinary ions and the fixation time of these atoms on other particles in suspension in the air are evaluated. A relationship between free atoms and bound atoms is established and verified experimentally. (tr-auth)

19645 THE UNIT CELL OF UMOHOITE $UO_2MoO_4 \cdot 4H_2O$. L. I. Anikina and E. S. Markarov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 942-3(Apr. 1, 1961). (In Russian)

Lane diagrams and various rotational and rocking diagrams were run on three of the best single crystals (0.1 to 0.2 mm) of umohoite. A powder diagram of umohoite was also obtained. The data obtained by these various methods are self-consistent and show that umohoite possesses a primitive monoclinic structure with cell dimensions of a = 6.32, b = 7.50, c = 57.8 A and $\beta = 94°$. Rotating the crystal around the c axis gave clear planar lines at spaced intervals of 57.8 A. Rocking the crystal in the xy plane gave a value of 94° for β. The space group of umohoite was determined on the basis of regularly occurring extinctions (absence of (OKO) reflections with odd k and of (h01) reflections with odd 1). Data on interplanar distances and on the intensities of various reflections are tabulated. (TTT)

19646 ON THE RADIOACTIVITY OF ROCKS OF THE PERZHAN INTRUSIVE COMPLEX. A. M. Ushakova (Kiev State Univ.). Geokhimiya, No. 4, 354-7(1961). (In Russian)

The radioactivity of rocks chiefly being developed in the boundaries of the so-called breaking-zone of the Perzhan intrusive in Sushchano-Perzhan has been studied. The limitation of heightened radioactivity to filmy and ochreous formations of grayish-dark, greenish-yellow and brown color in the fissures in the granite of Perzhan has been ascertained. If the uranium content in granite is on the average 25×10^{-4} percent, it varies in the filmy and ochreous formations from 37×10^{-4} percent to 72×10^{-4} percent. Among the latter the most radioactive are grayish-dark coatings, often with sulfides and fluorite, which, as a rule, fill up the steeply dropping fissures in the granite. A prevailing uranium content (Th/U = 0.66) is typical, being connected with minerals of the group of uranium oxides. The Th/U ratio in ochreous formations of greenish-yellow

and brown color is on the average 1.5. Their radioactivity is conditioned by autunite, uranocircite, clarkeite and soddyite. A heightened content of radioelements (U, 24×10^{-4} percent and Th, 10×10^{-3} percent) has been fixed in the Perzhan granite on the area of Perga-Rudnya Perzhanskaya where the processes of hydrothermal quartzization are most intensively developed. This is indicative of the considerable role of hydrothermal processes in the introduction of radioelements into rocks of the Perzhan intrusive. (auth)

19647 COSMOGENIC ISOTOPES IN THE YARDYMLEN METEORITE. L. K. Levskii (Academy of Sciences, Leningrad). Geokhimiya, No. 4, 358(1961). (In Russian)

Data are given on the rare-gas isotopic content of the Yardmlen iron meteorite of November 24, 1959. Values are reported for Ar^{40}, Ar^{38}, Ar^{36}, He^4, He^3, Ne^{20}, and Ne^{21}, and compared with values for the Sikhote-Alin meteorite. (T.R.H.)

19648 ON THE NATURAL RADIOACTIVITY OF ATMOSPHERE AND PRECIPITATION OVER THE NORWEGIAN SEA. S. G. Malakhov and L. D. Solodikhina (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 4, 620-4(Apr. 1961). (In Russian)

The natural atmospheric radioactivity (Rn decay products) over the Norwegian Sea, measured during June and July of 1958, was about 10 to 100 fold less than over the mainland. The natural radioactivity of precipitation over the sea was several fold less than in precipitation over the mainland. The mean magnitude of eight measurements was 0.27×10^{-11} c/g. (R.V.J.)

19649 EXTENSIONS OF THE 'CHAPMAN' THEORY OF LAYER FORMATION. C. H. Cummack (Geophysical Observatory, Christchurch, N. Z.). J. Geophys. Research, 66: 1685-97(June 1961).

An attempt was made to establish some of the theorems necessary for the extension of the Chapman theory of layer formation to the case where a spectrum of ionizing radiation acts on an atmosphere with any temperature profile. Some invariant properties of the electron production function were established, and they have proved useful in estimating the temperature and temperature variations in the ionosphere. (auth)

19650 DENSITY FLUCTUATIONS IN A PLASMA IN A MAGNETIC FIELD, WITH APPLICATIONS TO THE IONOSPHERE. Tor Hagfors (Stanford Univ., Calif.). J. Geophys. Research, 66: 1699-1712(June 1961).

General expressions are developed for the fluctuation in density of electrons, ions, and charge in a plasma in thermal equilibrium in an external magnetic field taking only Coulomb interaction into account. The spectral distribution of the spatial Fourier components of these fluctuations is derived from basic principles. The fluctuations in electron density are discussed in some detail, and spectra are computed under conditions that are thought to prevail in the outer ionosphere. Frequency spectra of general validity are computed for electron-density fluctuations along the magnetic field. It is shown that the frequency spectra under ionospheric conditions are little influenced by the magnetic field except for density fluctuations fairly close to perpendicularity to the magnetic field. Applications to incoherent backscattering are discussed, and under suitable conditions, backscatter techniques can give valuable information about electron density, temperature, and constituents of the ionosphere. (auth)

19651 THE DEUTERIUM CONCENTRATION IN ARCTIC SEA ICE. Irving Friedman, Beatrice Schoen, and Joseph Harris (U. S. Geological Survey, Washington, D. C.). J. Geophys. Research, 66: 1861-4(June 1961).

Samples taken from cores of sea ice collected near Ice Island T-3 at 80°18'N, 113°W, and on US-IGY Drifting Station Alpha at approximate locations of 85°40'N, 127°W, and 83°N, 165°W, were analyzed for their relative deuterium content. A plot of deuterium concentration vs. depth in the ice, from the T-3 ice core, shows three positions of minimum deuterium concentration. These minima are interpreted as being due to the formation in the summer, and freezing in the early winter, of a surface layer of water of low deuterium concentration. This layer forms by the mixture of sea water with water from melted precipitation that is low in deuterium. The sea ice floats on this deuterium-poor layer, and this layer is the first material to be added to the ice floe when accretion by freezing begins in the early winter. Several samples of surface water collected during the summer of 1958 at 86°44'N, 77°55'W, and 89°18.5'N, 45°00'W, prove the existence of such a deuterium-depleted layer at these locations. Two cores taken on US-IGY Drift Station Alpha at approximate locations of 82°N, 165°W, and 85°N, 127°W, show no such clear deuterium variation because (1) in the 2 or 3 years preceding ice collection precipitation was much less than at the other locations sampled, and (2) vertical mixing was greater than at the other locations. (auth)

19652 PHOTOGRAMMETRIC TECHNIQUE FOR STUDYING ATMOSPHERIC DIFFUSION. Peter E. Wasko and Harry Moses (Argonne National Lab., Ill.). Photogram. Eng., 92-8(Mar. 1961).

A photogrammetric technique is described for studying atmospheric diffusion. Three type K-24 aerial cameras, operating simultaneously, photograph fog-oil smoke plumes emitted from a 111-foot stack. The photographs are analyzed by means of a photogrammetric analyzer which simulates actual field conditons. Measurements of the cross-sectional area of the plume, the rate of change of the cross-sectional area of the plume, i.e., its divergence, and a measure of the area covered by the meander of the plume's center line at various distances from the stack are presented. (auth)

19653 ISOTOPIC COMPOSITION OF URANIUM IN NATURE. E. A. Isabaev, E. P. Usatov, and V. V. Cherdyntsev. Radiokhimiya, 2: 94-7(1960). (In Russian)

The isotopic composition of uranium in natural minerals and waters was analyzed. The ratio of U isotopes in minerals saturated by actinium does not deviate from ordinary. The U^{238}(UI) and U^{234}(UII) varies considerably in secondary metals and natural waters. Tests on 29 water specimens from granites indicated variations from 0.72 to 7.8, with an average of 3. (R.V.J.)

19654 DETERMINATION OF ACTINIUM IN MINERALS. E. A. Isabaev, U. Kh. Asylabaev, and V. V. Cherdyntsev. Radiokhimiya, 2: 98-103(1960). (In Russian)

Small quantities of Ac in the presence of Th were determined by measuring AcC and ThC with an α analyzer and by determining Rn^{219}(An) and Po^{215}(AcA) by counting retarded pulses with a luminescence counter. The existence of primary minerals saturated with actinium was confirmed, and secondary minerals with an increased actinium-radium ratio are discussed. (R.V.J.)

19655 ISOTOPIC VARIATIONS IN METEORIC WATERS Harmon Craig (Univ. of California, La Jolla). Science, 133: 1702-3(May 26, 1961).

The relationship between deuterium and O^{18} concentration

n natural meteoric waters from many parts of the world is etermined with a mass spectrometer. The isotopic enrich- ients, relative to ocean water, display a linear correlation ver the entire range for waters which have not undergone xcessive evaporation. (auth)

9656 IONIUM-THORIUM CHRONOLOGY OF DEEP-EA SEDIMENTS OF THE WESTERN NORTH PACIFIC OCEAN. Yasuo Miyake and Yukio Sugimura (Meterological Research Institute, Suginami, Tokyo). Science, 133: 1823-(June 9, 1961).

The rate of deposition of deep-sea deposits collected at lepths of 6215 to 8450 m in the western part of the North Pacific Ocean was estimated by means of the ionium/ horium ratio. The ratio was determined by an α spectrometer. Results showed the rate of 0.5 to 0.8 mm/10^3 yr for the upper 10-cm layer below the sea bottom. (auth)

19657 STANDARD FOR REPORTING CONCENTRATIONS OF DEUTERIUM AND OXYGEN-18 IN NATURAL WATERS. Harmon Craig (Univ. of California, La Jolla). Science, 133: 1833-4(June 9, 1961).

A standard, based on the set of ocean water samples used by Epstein and Mayeda to obtain a reference standard for oxygen-18 data, but defined relative to the National Bureau of Standards isotopic reference water sample, is proposed for reporting both deuterium and oxygen-18 variations in natural waters relative to the same water. The range of absolute concentrations of both isotopes in meteoric-waters is discussed. (auth)

HEALTH AND SAFETY

19658 (ANL-6297) RADIOLOGICAL PHYSICS DIVISION SEMIANNUAL REPORT, JULY THROUGH DECEMBER 1960. (Argonne National Lab., Ill.). Feb. 1961. Contract W-31-109-eng-38. 133p.

Data are presented from studies on the total Ra^{226} content, radon retention, and activity of hotspots in human bones approximately 30 yr post-administration of Ra. Preliminary results are reported from a study of the incidence of bone tumors following injection of Pu^{239}, Ra^{226}, Sr^{90}, or Ca^{45} in mice. Calculations were made of the radiation dose from hotspots formed in bone by these radioisotopes. The γ spectra of 20 subjects who contained known quantities of K^{42} were obtained with several different sized NaI(Tl) crystals located at various points around the body. These spectra were analyzed to determine the variations in counting rates that resulted with each patient-crystal arrangement. The total-body γ spectra of 12 unexposed employees were measured with the human spectrometer over a span of 30 mo. Data are tabulated on Co^{137}/K^{40} ratios. The response of a scintillation counter to γ radiation as a function of incidence angle was measured. Studies were made on the refractive index of selected optical media. Improvements were made in the design and in the scintillator solvent for a twin scintillation fast neutron detector. Measurements were made of the skeletal and soft tissue content of Ra in normal humans whose primary source of Ra was food. Calculations of the half lives and distributions of stable Pb and Pb^{210} in the human body are discussed. Meteorological studies reported include a comparison of observed plume rise of stack effluent with values obtained from well-known formulas, towing tank studies of horizontal turbulent air flow, and soil temperature studies. (C.H.)

19659 (ARF-3127-18) PRELIMINARY STUDIES OF SCAVENGING SYSTEMS RELATED TO RADIOACTIVE FALLOUT. Summary Report, May 1, 1960 to March 31, 1961. John Rosinski (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 28, 1961. Contract AT(11-1)-626. 44p.

Experimental investigations of aerosol particle capture by evaporating and condensing water drops showed that capture is a function of the rate of water drop growth and aerosol particle diameter. Capture was found to be proportional to the rate of water vapor condensation and inversely proportional to aerosol particle diameter. The influence of water vapor gradient and particle size on particle capture during evaporation is insignificant. The results are explained on the basis of particle penetration through the boundary layer of a water drop. An analysis of the radioactivity of dry particulate matter in an urban atmosphere is included. (auth)

19660 (BLG-53) THE REMOVAL OF GASEOUS IODINE FROM AIR WITH PARTICULAR REFERENCE TO REACTOR ACCIDENTS. R. Lopes Cardozo and P. Dejonghe (Brussels. Centre d'Étude de l'Énergie Nucléaire). Nov. 25, 1960.

After explaining why an iodine filter installation is necessary for some reactors, the paper goes on to show why activated charcoal is a suitable filter material if it is preceded by a KI-coated glass wool filter. The results of some experiments with small scale activated charcoal filters are given. It was possible to establish a connection between the efficiency of an activated charcoal trap and factors like the total amount of iodine present, face velocity, etc. Some experiments with KI-treated glass wool and other filter materials are reported. It is recommended that activated charcoal not be used at temperatures higher than 65 to 75°C. Appended are a method of calculating the temperature rise in charcoal due to the heat generated by radioiodine and a calculation for a 10,000 ($m^3 \cdot h^{-1}$) iodine filter. It is shown that an activated charcoal filter with a filtering surface of 6 m^2 and a filtering depth of 5 cm will have an efficiency of more than 99.999% for gaseous iodine. (auth)

19661 (CF-59-5-90) NUCLEAR AND RADIATION HAZARDS EVALUATION OF SRE FUEL PROCESSING AND STORAGE. J. C. Suddath (Oak Ridge National Lab., Tenn.). May 20, 1959. 3p.

Results are presented of an evaluation of nuclear safety and radiation control related to the shipment, mechanical processing, and storage of SRE-1 fuel elements. (auth)

19662 (CNI-43) MISURE DI RADIOATTIVITÀ AMBIENTALE. ISPRA 1958-1959. (Measurements of Environmental Radioactivity, Ispra 1958-1959). A. Anzani, A. Benco, G. Dominici, P. Gaglione, C. Gandino, A. Malvicini, and L. Vido (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). 28p.

Measurements of radioactive contaminations made in 1958 and 1959 at Ispra, for the control of environmental radioactivity are reported. Great importance is given to measurements of strontium-90 and cesium-137 in food chains. (auth)

19663 (DP-329) A SYNOPSIS OF STUDIES RELATED TO TRITIUM MONITORING AND PERSONNEL PROTECTIVE TECHNIQUES. Harry L. Butler and Robert W. Van Wyck, comps. (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Feb. 1959. Decl. Aug. 31, 1960. Contract AT(07-2)-1. 17p.

Information obtained from investigations pertinent to tritium monitoring and protective measures at the Savannah River Plant are given. These findings were used to establish realistic protective techniques and consequently, to insure the safety of workers exposed to this hazard. Topics included are: contamination, permeation of plastics and rubber, instrumentation, and biological and physical aspects. (auth)

19664 (HW-61236(Suppl. 2) PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS. SUPPLEMENT 2. CONSEQUENCES OF A PRIMARY COOLANT LEAK. N. G. Wittenbrock and J. Muraoka (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 15, 1960. Contract AT(45-1)-1350. 77p.

The emergency light water injection system is designed to automatically supply coolant to the reactor upon loss of the primary coolant. Two separate systems are provided for light water injection, a high pressure system supplied by the boiler feed pumps and a low pressure injection system supplied by the diesel driven well pump. The high pressure light water injection system can provide an adequate supply of back up coolant for primary system leaks of any size. However, if lightwater injection must be accomplished with the low pressure injection system, for example because of boiler feed pump failure, a small leak would necessitate rapid depressurization of the primary coolant system so that light water could be injected before any fuel element melting occurred. A 2-inch vent valve on the pressurizer, opened automatically upon initiation of

light water injection, is provided for rapid depressurization of the primary coolant system. Leaks in the primary coolant system have been shown to have little effect on reactivity. Process tube ruptures have a negative reactivity effect, except when the primary coolant is cold and pressurized. A process tube leak when the primary coolant is cold and pressurized, would result in a very small positive reactivity addition of 0.25 mk. After light water injection has been started, the size and location of the leak will determine what action must be taken to assure continued adequate cooling. For a leak in the upper access space, a process tube leak, a leak in the heat exchanger leg, and a small leak in the lower access space, the 14-inch valve in the primary coolant outlet line should be opened. However, for a large leak in the lower access space, the 14-inch valve must be kept closed. (auth)

19665 (IDO-14550) SAFETY CONSIDERATIONS IN AQUEOUS REPROCESSING PLANT OPERATIONS. W. G. Morrison (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 1, 1961. Contract AT(10-1)-205. 31p.

Safety precautions utilized for control and confinement of fissionable and radioactive materials in the various aqueous reprocessing operations performed at the Idaho Chemical Processing Plant are presented. Three primary nuclear safety controls, geometrical, mass limitation, and concentration control, are used. Operations are performed according to standard operating procedures which are set up to prevent circumvention of the primary nuclear safety controls. The various processing operations with their particular safety features are discussed. The operations include receipt, handling, and storage of irradiated fuel elements, dissolution of the fuel elements in various reagents, separation of the unburned fissionable material from fission products and fuel element structural materials by solvent extraction, salvage or recycle operations of off-specifications product or waste solutions that exceed the disposable fuel concentration limits, product packaging, storage and shipment, fission product recovery, and waste collection, handling and disposal. The original plant design and later additions and modifications included built-in geometrical control wherever practical with allowances for possible neutron interaction between vessels. The standard operating procedures specifically state mass limits and concentration controls required for certain operations which involve appreciable quantities of uranium. Administrative control insures compliance with the standard operating procedures. (auth)

19666 (LAMS-2499) BETA-GAMMA RADIOACTIVITY IN ENVIRONMENTAL AIR AT LOS ALAMOS, NEW MEXICO, FOR 1960. William R. Kennedy (Los Alamos Scientific Lab., N. Mex.). Jan. 30, 1961. Contract W-7405-ENG-36. 23p.

Data are tabulated on the radioactivity in samples of air and water collected at Los Alamos Scientific Laboratory during 1960. (C.H.)

19667 (NAA-SR-Memo-2917) OMR ORGANIC FIRE AND EXPLOSION HAZARD STUDY, 12eMW. R. A. Shelden (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 24, 1958. 12p.

The fire and explosion hazard associated with the operation of the OMR Piqua reactor and related equipment containing approximately 10,000 gal of Santowax R, an organic coolant, under conditions of high temperature and pressure was evaluated. Santowax R in solid form was found to offer little hazard unless dust concentrations in the air become greater than 0.035 oz/ft^3. Spontaneous self-ingnition of the coolant either within or outside the system is considered to be extremely unlikely. The coolant is above the flash and flame points in the conditions considered and is therefore very flammable if released into the atmosphere in the presence of an ignition source. Large coolant leaks into the cell could be readily detected by white smoke and odor. The minimum concentration of organic vapor presenting an explosion hazard is about 10,000 times greater than the maximum concentration with respect to organic toxicity breathing hazard. (M.C.G.)

19668 (NP-10161) INTRODUCTORY MANUAL ON THE CONTROL OF HEALTH HAZARDS FROM RADIOACTIVE MATERIALS. Medical Research Council Memorandum No. 39. (Gt. Brit. Medical Research Council, London). 1961. 26p.

The nature of the hazards involved in working with radioactive materials is reviewed. Precautions are outlined which should be taken to ensure safe procedures. (C.H.)

19669 (NP-10188) HAZARDS SUMMARY REPORT FOR DIAMOND ORDNANCE RADIATION FACILITY. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). [1960?]. 156p.

A hazards analysis for the DORF-TRIGA reactor to be located in the Forest Glen Annex of Walter Reed Medical Center is presented. The analyses are supported by experimental data from tests on the Mark F prototype and operating experience of other TRIGA reactors. It is concluded that with the necessary administrative control the reactor does not present an undue hazard to the health and safety of operating personnel or the public. (J.R.D.)

19670 (ORO-402) HAZARDS SUMMARY REPORT FOR THE UNIVERSITY OF PUERTO RICO NUCLEAR REACTOR. (AMF Atomics, Inc., Greenwich, Conn.). Mar. 1960. Contract AT(40-1)-2422. 236p.

A hazards survey was made of the University of Puerto Rico Reactor. The safety features planned for operation and incorporated in the design of the facilities are discussed under the following headings: reactor description, reactor design, reactor building, reactor operation, site analysis, and hazards. Natural hazards, minor accidents, maximum start-up accident, credible serious accidents, maximum credible accident, and maximum hypothetical accident are reviewed to determine resulting on-site and off-site hazards and methods for the prevention and containment of these accidents are discussed. (M.C.G.)

19671 (TID-3909) AN ATOMIC RADIATION BIBLIOGRAPHY. A List of Reports Submitted to the United Nations Scientific Committee on the Effects of Atomic Radiation. Alfred W. Klement, Jr., comp. (Division of Biology and Medicine. Fallout Studies Branch, AEC). Mar. 1, 1961. 72p.

The reports listed herein are those which have been submitted to the United Nations Scientific Committee on the Effects of Atomic Radiation from member governments and certain international agencies and organizations. The reports listed are, in general, technical papers and reports dealing with natural and man-made radiation and radiation effects on biological systems. This list has been prepared from actual reports received before March 1, 1961, information furnished by the Office of Special Projects, and Nuclear Science Abstracts (NSA). Supplements to this list will be issued as warranted. (558 references.) (auth)

19672 (USNRDL-TR-505) SOME CRITICAL OBSERVATIONS CONCERNING THE HANDLING OF HIGH LEVELS

OF TRITIUM RADIOACTIVITY. B. E. Vaughan and A. K. Davis (Naval Radiological Defense Lab., San Francisco). Apr. 17, 1961. 18p.

The data presented demonstrate substantial non-volatile transfer of tritium from contaminated surfaces to skin by direct contact. Since radioactivity on the contaminated surfaces is not necessarily detectable by gas-flow monitoring methods, this route of entry of tritium into body tissue must be considered an unrecognized, potential hazard, where the handling of apparatus exposed to high levels of tritium is concerned. The lability of contact-transferred tritium in skin, its chemical form and location within the skin, and the exact radioactivity content of the contaminated surfaces are particular problems remaining to be established by exact methods. The demonstration of non-volatile contact transfer is reported here because of its significance to health safety practice. (auth)

19673 (USNRDL-TR-507) CALCULATION OF RADIATION DOSE RATE FROM CYLINDRICAL AIRBORNE FISSION-PRODUCT SOURCES. E. S. Shapiro and I. O. Huebsch (Naval Radiological Defense Lab., San Francisco). May 1, 1961. 40p.

A mathematical expression for radiation dose rate is developed for the case of a cylindrical source, using an effective attenuation coefficient for the spectrum of gamma ray energies of the fission-product mixture for a given time after fission. The expression has been evaluated numerically, and the resulting dose-rate ratios are presented in tabular form for various sizes of cylinder and distances from cylinder axis to receiver. The results are presented in tables of dose-rate ratios, that is, the ratio of the dose rate at a given distance from a cylindrical source of given dimensions and activity density to the dose rate within an infinite homogeneous volume having the same activity density. A rapid, approximate method of determining many additional values of the dose-rate ratio is given. (auth)

19674 RADIOACTIVE PROTECTION WITH ISOTOPE INSTRUMENTS EMPLOYED IN INDUSTRIAL MEASURING AND CONTROL ENGINEERING IN THE GERMAN DEMOCRATIC REPUBLIC. R. Heimann (VEB Vakutronik, Dresden). Isotopentechnik, 1: No. 4, 119-21(Mar. 1961). (In German)

After a discussion of the regulations of importance to the discussed range of application of radioactive isotopes, appliances and measures are listed which ensure protection in the use of enclosed emitters. (auth)

19675 INACTIVATION OF DRINKING WATER CONTAINING P^{32} AND Sr^{89} BY THE METHOD OF CONTACT COAGULATION. Z. Ya. Gorodishcher and N. I. Mashneva (Inst. of Radiation Hygiene, Ministry of Public Health, USSR). Med. Radiol., 6: No. 2, 52-6(Feb. 1961). (In Russian)

Investigations are reported concerning decontamination of drinking water on three model plants of contact purifiers, which differed by the height of the filtrating layer and the size of the grains. (auth)

19676 CESIUM-137 IN AIR, PRECIPITATION, DRINKING-WATER, MILK AND BEEF IN NORWAY DURING 1959 AND 1960. T. Hvinden and A. Lillegraven (Norwegian Defence Research Establishment, Kjeller). Nature, 190: 402-4(Apr. 29, 1961).

Data are presented graphically on the levels of Cs^{137} in samples of air, precipitation, drinking water, milk, and beef collected in Norway during 1959 and 1960. (C.H.)

19677 THE UNITED STATES NAVAL RADIATION EXPOSURE EVALUATION CENTER. E. R. King and T. G. Mitchell (U. S. Naval Hospital, Bethesda, Md.). p.129-44 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Facilities of the U. S. Naval Radiation Exposure Evaluation Center are described. While the facilities are designed to handle personnel exposed to radiation due to peacetime accidents or incidents, the planning could be applied to wartime casualty exposure. The facility consists of a receiving ward, decontamination and monitoring stations, wards, and clinical and radioassay laboratories. Plans are outlined for an enlarged facility which will include whole-body counting facilities. Clinical investigations and research will also be carried out in the new facilities. (C.H.)

19678 DOSIMETRY OF INTERNAL RADIOACTIVE ISOTOPES. K. Z. Morgan (Oak Ridge National Lab., Tenn.). p.153-72 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Procedures, other than whole-body counting, which may be used to measure the absorbed dose delivered by radionuclides inside the body are discussed. These include small radiation detection instruments implanted in the body or inserted into various body cavities, semiconductor devices, analysis of body excretions, and analysis of body tissues. Applications of measuring and mathematical procedures in dose determinations are discussed. Examples are presented of the calculated radiation dose to the testes and ovaries resulting from a number of internally deposited γ-emitting fission products. Problems in obtaining proper maximum permissible concentrations (MPC) for natural Rn^{222} are discussed. Assumptions and formulas used in the calculation of internal radiation dose are reviewed. (C.H.)

19679 DISTRIBUTION IN TISSUE OF DOSE FROM PENETRATING GAMMA AND NEUTRON RADIATIONS. V. P. Bond, G. W. Imirie, E. P. Cronkite, and E. E. Stickley (Brookhaven National Lab., Upton, N. Y.). p.173-84 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961. (BNL-4747)

Results are reported from experiments in which phantoms, constructed to simulate the torso of a man, were instrumented for gamma and neutron depth dose measurements and exposed to the initial γ and neutron radiations from exploding nuclear devices. The dosimeters are described and results are presented graphically. Sufficient data were obtained to characterize reasonably well the central-axis initial γ depth dose pattern in a human phantom and to indicate the general nature of the fast neutron depth dose curve. (C.H.)

19680 RADIUM AND MESOTHORIUM. John B. Hursh (Univ. of Rochester, N. Y.). p.185-94 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The measurement of Ra^{226} and Ra^{228} in man by whole-body counting techniques is discussed. It is pointed out that the whole-body NaI crystal technique was developed as a tool for the whole-body counting of Ra^{226} and that extensive data have been accumulated on the chronic biological effects of Ra^{226} in man. The decay scheme for the U and Th series is reviewed, and the spectrum of Ra^{228} plus Ac^{228} and the spectrum of Ra^{224} and its daughters are discussed. Data are included from measurements of γ activity in some selected foods. It is concluded that satisfactory measurements of Ra^{226} and Ra^{228} can be made by more or less routine whole-body counting techniques. (C.H.)

19681 Na^{24} ACTIVATION IN THE DOSIMETRY OF NUCLEAR ACCIDENTS. J. A. Auxier, F. W. Sanders, and W. S. Snyder (Oak Ridge National Lab., Tenn.). p.201-11 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

A system of neutron dosimetry is described which employs Hurst threshold detectors to give the approximate form of a neutron spectrum, chemical dosimeters and shielded metaphosphate glass dosimeters to give the dose from photons, and the activation of blood Na to provide a means of normalizing the computed dose. Applications in the dosimetry of nuclear accidents are discussed. If all components of the dosimetry system are in place and functioning, it is possible to estimate the dose by duplicating the excursion and thus obtaining the neutron spectrum and the ratio of γ dose to neutron dose. Na activation in the blood of exposed persons can be compared with Na activation produced in a mock run. Results are included from a series of studies on factors affecting Na activation in blood. (C.H.)

19682 GAMMA RAY ACTIVITY OF REACTOR PERSONNEL AS DETERMINED BY THE WALTER REED WHOLE BODY COUNTING FACILITY. Charles L. Randolph (Walter Reed Army Medical Center, Washington, D. C.). p.212-18 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

A whole-body counting facility for detecting γ activity in humans was used in a survey of personnel engaged in the operation of the Army Package Power Reactor (APPR-1). Twenty-five % of the personnel showed levels of γ activity above that of the unexposed population. The levels were less than established levels for maximum permissible body burdens. (C.H.)

19683 THE BIOLOGICAL HAZARDS OF A FALLOUT FIELD. Robert A. Conard (Brookhaven National Lab., Upton, N. Y.). p.249-65 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961. (BNL-4720)

The biological hazards from an acute fall-out exposure are discussed. Results are reviewed from a number of studies on the people of Rongelap Atoll in the Marshall Islands who were accidentally exposed to an acute fall-out situation in 1954. Annual medical surveys have been carried out and data collected through 1960 are included. A steel room with 4-in. thick walls was constructed for use in carrying out whoel-body γ spectroscopy measurements on the exposed people. It is concluded that the most serious hazard associated with acute fall-out comes from penetrating γ exposure which may result in acute radiation syndromes. Beta burns of the skin may be moderately incapacitating but the hazard is not considered serious. The hazard from internal absorption through ingestion or inhalation is not considered serious during the period of acute exposure. The Marshalese people received near maximum permissible levels of some isotopes early, but there was rapid excretion. Chronic and late effects include questionable effects on metabolism as suggested by temporary weight loss, a slight lag in growth and development of exposed children, and increased incidence of miscarriages and stillbirths in exposed women. (C.H.)

19684 THE ROLE OF WHOLE BODY COUNTERS IN THE EVALUATION OF HAZARDS. Merril Eisenbud (New York Univ., Bellevue Medical Center, New York). p.323-33 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Applications of whole-body counting techniques in estimating radiation hazards from internally-deposited radioisotopes are discussed. It is pointed out that whole-body measurements of human radioactivity provide the most accurate method of evaluating hazards from radioactive materials. The status of the Japanese fishermen on the Lucky Dragon and the natives of Rongelap Island exposed to acute fall-out from the thermonuclear explosion of March 1, 1954, are reviewed. Data on internal contamination obtained by analysis of urine are compared with later data obtained on the Marshall Islanders by whole-body counting. It is pointed out that it is not practical to use a whole-body counter immediately following exposure to a massive release of radioactivity, and that whole-body counting should be done only after an extensive period for decontamination and after short-lived radionuclides are no longer dominant. The radioisotopes which present a potential human risk include natural and enriched U, Pu^{239}, Po^{210}, Ra^{226}, Th^{232}, and Sr^{90} Most of these radionuclides, with the exception of Ra, do not lend themselves to convenient in vivo determination because the radiations they emit are not sufficiently penetrating. It is concluded that the greatest contribution of the whole-body counter in hazards evaluation lies in studies on the rates and routes by which radionuclides are excreted. (C.H.)

19685 A STUDY OF ATTITUDES TOWARD NUCLEAR RADIATION AMONG DAVIDSON COUNTY, TENNESSEE, RESIDENTS. Edward L. McDill, Jeanne Clare Ridley, and Eugene A. Weinstein (Vanderbilt Univ., Nashville). p.343-54 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Data are summarized from structured interviews based on an area probability sample of 283 white, non-farm households. One adult member of each household was interviewed as to knowledge and attitudes involving nuclear radiation and medical x-ray examinations. Variations in knowledge, perception, and attitudes were found to be related to socio-economic background, with upper levels tending to be more informed. Although 98% of those interviewed were aware of the existence of nuclear energy, only 56% could name a use for it other than the atomic bomb. Thirty-nine percent of those interviewed expressed the opinion that medical x-ray examinations are completely safe, while 7% considered them very dangerous. Almost 60% of those who described nuclear radiation indicated fear, and less than 1% gave sophisticated definitions of terms commonly associated with nuclear radiation. It was concluded that despite all the publicity given to nuclear energy and radiation in communication media, the public is not well informed. (C.H.)

19686 RADIATION AND THE LAW: WITH EMPHASIS ON DAMAGE AND PROOF PROBLEMS. Samuel D. Estep (Univ. of Michigan, Ann Arbor). p.355-72 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Legal questions involving nuclear energy are reviewed, with emphasis placed on questions involving damage and proof. Topics discussed include policy decisions in regard to atomic energy, administrative law decisions, federal-state relations in regard to control of nuclear radiation and waste disposal, and problems of liability and radiation injury. (C.H.)

19687 RADIOACTIVITY IN MAN: IMPLICATIONS FOR THE FUTURE. Charles L. Dunham and H. D. Bruner (U. S. Atomic Energy Commission, Washington, D. C.). p.399-401 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The possible effects of exposure to prolonged low-level radiation are discussed. It is pointed out that among the populations of Hiroshima and Nagasaki there has been observed an increased incidence of leukemia, a few clinically significant radiation cataracts, and a slight increase in the mutation rate, as evidenced by a slight change in the sex ratio of newborn infants. There have been no careful

observations made of populations whose lifetime exposure to external γ radiation are of the order of 10 times natural background, though such populations exist in India and Brazil. There are also populations in the Midwestern U. S. whose water supplies contain Ra in quantities exceeding by 3 or 4 times the recommended maximum permissible concentration. These populations should be carefully studied to determine the validity of data on radiation dose levels developed from observations on experimental animals and to develop statistically sound techniques for future studies of the effects of various environmental factors on disease incidences in selected population groups. (C.H.)

19688 RADIOACTIVE MATERIALS IN MAN AND HIS ENVIRONMENT: THE CHARACTER AND MAGNITUDE OF THE PROBLEM. Russell H. Morgan (Johns Hopkins Univ. and Hospital, Baltimore). p.403-7 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The hazards to man of natural and artificial radioactivity are reviewed. It is pointed out that a considerable portion of the population is exposed to radioactive materials by occupational routes, but the greatest exposure of the general population comes from fall-out. Fall-out is influenced principally by meteorological conditions and may involve a special hazard to invididuals in the local fall-out area. The hazards to man from Sr^{89}, Sr^{90}, I^{131}, Ba^{140}, Cs^{137}, Zr^{95}, Ru^{103}, Ru^{106}, and Ce^{144} in fall-out are discussed. (C.H.)

19689 HEALTH HAZARDS IN MODERN SOCIETIES: SOME ETHICAL AND LEGAL PERSPECTIVES. James H. Sterner (Eastman Kodak Co., Rochester, N. Y.). p.409-13 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The health problems for society that are created by the development of nuclear radiation are discussed. It is pointed out that these new problems may have many analogies with those of other environmental hazards. Other important environmental health hazards include chemical substances used as food additives, insecticides, water pollution, medications, cosmetics, and many household products. The author concludes that our approach to the radiation health problem is unique, in that great concern is shown for levels of exposure which thus far have not been associated with clearly demonstrable human injury. (C.H.)

19690 PUBLIC HEALTH SERVICE RESPONSIBILITIES IN RADIOLOGICAL HEALTH. Francis J. Weber (U. S. Dept. of Health, Education and Welfare, Washington, D. C.). p.415-21 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The public health aspects of ionizing radiation are discussed. Pertinent public health concepts and procedures are reviewed. It is pointed out that in view of the variety of sources of radiation, control must be approached in a number of different ways, each differing somewhat in its details. A radiation control program must make provisions for a good surveillance system to enable an accurate estimate of the total exposure and respective contributions of components of the source. The importance of a program of education and training in the field of radiological health is stressed. (C.H.)

19691 INDUSTRIAL TRENDS AND REQUIREMENTS IN THE UTILIZATION OF ATOMIC ENERGY. George White (General Electric Co., San Jose, Calif.). p.423-5 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The contributions of reactors, radioisotopes, and radiation to society through increased productivity and increased knowledge are reviewed. It is pointed out that the trend of industry has been toward excellent control of exposures to radiation for employees and the public. The need for sound legislation for radiation protection and the development of improved techniques to assure radiation protection for employees and the public are discussed. (C.H.)

19692 MILITARY DEVELOPMENT AND PUBLIC HEALTH AND SAFETY. John B. Youmans (U. S. Army Medical Research and Development Command, Office of the Surgeon General, Washington, D. C.). p.427-31 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

The Army nuclear reactor program is reviewed briefly. The health and preventive medicine aspects are illustrated by a description of procedures employed at the SM-1, a pressurized water reactor operated by the Army at Fort Belvoir, Va. Hazards to the public from the transport of nuclear weapons and the Army study on radioactivity induced in foods are also discussed briefly. (C.H.)

19693 FORENSIC PROOF OF RADIATION INJURY. Gerald L. Hutton (U. S. Atomic Energy Commission, Washington, D. C.). p.439-45 of "Radioactivity in Man." George R. Meneely, ed. Springfield, Ill., Charles C Thomas, 1961.

Legal problems that may arise from the use of radiation are discussed. It is pointed out that even though disease is proved and a causal relationship is established between such disease and ionizing radiation it may be difficult to prove, or disprove, that the radiation injury occurred at a particular time or place. The importance is stressed of establishing and maintaining good, meaningful, and detailed records of radiation exposure. (C.H.)

19694 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, FEBRUARY 1961. Vol. II, No. 2. (Public Health Service, Washington, D. C.). 53p.

Data are tabulated on the radioactivity in samples of air, milk, food other than milk, and water collected in the U. S. during 1960. Results are included from a survey on the radioactive contamination of jet aircraft resulting from in-flight accumulation of radioactive particles on the surface, the radioactivity in tissues from cattle maintained on the Nevada Test Site, the Sr^{90} content in bone samples, and a survey on environmental levels of radioactivity at AEC installations. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

19695 (GMR-159) LIST OF SELECTED REFERENCES PERTAINING TO THE INDUSTRIAL APPLICATIONS OF RADIOISOTOPES AND RADIATION. W. D. Cheek and B. J. Riley (General Motors Corp., Detroit). Mar. 17, 1958. 10p.

The list is divided into the following sections: current periodicals; books; review articles; technical memorandums; and selected journal articles. The journal articles are categorized into uses of radiation as sources, tracers, and for studies of beneficial and detrimental effects on materials. 161 references. (B.O.G.)

19696 (NYO-2764) THE STUDY OF INVERSE RADIOACTIVE TRACER TECHNIQUES AND APPLICATIONS OF RADIOACTIVE QUINOL CLATHRATES. Second Annual Report. Richard Bersin, Frederick J. Brousaides, David Chleck, Carlton O. Hommel, and James C. McCue (Tracerlab, Inc., Waltham, Mass.). July 1, 1960. Contract AT(30-1)-2204. 107p.

An investigation was made of chemical analyzers based on the technique of radioactive tracing. Reactions were studied which could lead to the evolution of a gaseous product which contains a radioactive atom. Correlations between counting rates and influent concentrations of reactant to be analyzed were then made. Efforts to develop a radiochemical tracing method for low concentrations of water in a gas stream utilizing a variety of systems are described. Compounds studied as potential tracers included lithium aluminum tritide, sodium amide, phosphorus pentachloride, and titanium trichloride. None of these systems were entirely satisfactory at water concentrations below 1000 cpm due to the "sealing-off" of salt surfaces by reaction products. The feasibility for radiochemical tracing of HCl, Cl_2, and O_3 was demonstrated using Kr^{85} quinol clathrate coupled with $NaClO_2$. Strong emphasis was placed on the detection of ozone using Kr^{85} quinol-clathrate, and application of the method to high altitude atmospheric analysis. The reaction is sensitive (< 1 ppb at NTP) and data are presented to establish feasibility and merit. Further applications of Kr^{85} quinol-clathrate were studied. The production of low energy x radiation using clathrates and suitable targets is shown to be feasible, practical, and desirable. Uses in radiography, x-ray analysis, therapy, and x-ray measurements are indicated. The preparation of luminous paints with clathrates was accomplished by conventional direct compounding and by an "in situ" technique. In the latter method the inclusion of the activity was made automatically and remotely in a final stage of fabrication. (auth)

19697 (NYO-9702) DEVELOPMENT OF A GAS INJECTOR SYSTEM FOR HOMOGENEOUSLY LABELING GAS STORAGE RESERVOIRS. Final Report. Curtis Sewell and Isidor Schulz (Isotopes, Inc., Westwood, N. J.). May 1, 1961. Contract AT(30-1)-2327. 100p.

The laboratory experiments and field testing which were carried out in the development of a homogeneous gas labeling device are described. Detailed drawings of the injector and its most critical components are included. Recommendations are made for a production model of the device along with estimated costs of construction. (D.L.C.)

19698 STUDIES IN THE STORAGE OF CHESTNUTS TREATED WITH GAMMA RADIATION. II. Takashi Iwata and Kuniyasu Ogata (Univ. of Osaka Prefecture, Sakai, Japan). Bull. Inst. Chem. Research, Kyoto Univ., 39: 112-19(Mar. 1961).

Two varieties of chestnuts were irradiated with relatively high doses of gamma rays, purporting the extension of storage life of the nuts through the inhibition of rooting and sprouting. The materials were treated with the doses of 1.5, 3, and 6×10^4 r, 6 weeks after harvest and then stored in moist sawdust at 20°C. An almost complete inhibiting effect was obtained with all of the doses used regardless of varieties. The contents of ascorbic acid and of reducing sugar were not influenced directly by any dose of irradiation, but the content of non-reducing sugar was affected to some extent. A sharp increase of respiration was found both in the whole nuts and in the cotyledon part of the nuts immediately after irradiation. In the embryonic axis part of the irradiated nuts, the respiration did not show any change for a considerable period after irradiation; it became fairly lower than the control from the time when some control nuts initiated rooting, and the discoloration of this part took place about the same time. There was a rapid increase of rot incidence when the irradiated nuts have been stored for 4 months at 20°C. (auth)

19699 EXPERIMENTS ON THE PRESERVATION OF FRESH FRUIT BY IRRADIATION. D. de Zeeuw (Inst. for Atomic Sciences in Agriculture, Wageningen, Netherlands). Food Irradiation, 1: No. 3, A5-A7(Jan.-Mar. 1961).

Soft fruits, such as strawberries, raspberries and plums, were irradiated by means of an electron accelerator. The fruits were placed in small plastic boxes and irradiated on both sides with 1 Mev-electrons. The irradiation dosages varied from 0 to 700 kilorads. The storage temperature was usually 15°C. In general the consistency of soft fruits, irradiated with dosages of 300 to 700 kilorads, was superior to that of the non-irradiated fruits. It seems that a medium dose treatment affects both the shelf-life time and the ripening of fruit. In order to investigate the effect of ionizing radiation on the ripening process of fruit, experiments were carried out with tomatoes in different stages of maturity. In these investigations tomatoes were used because they do not get mouldy during a long storage period. Consequently, there is no interference of the metabolism of the micro-organisms with that of the tomato. In measuring the CO_2 production, it appeared that with mature green tomatoes this was considerably increased immediately after irradiation. However, there was no difference between the CO_2 production of irradiated and non-irradiated tomatoes of the turning mature stage. (auth)

19700 PRIMENENIE RADIOAKTIVNYKH IZOTOPOV DLYA AVTOMATIZATSII VUGOL'NOI PROMYSHLENNOSTI. (Applications of Radioisotopes in Coal Industry Automation). V. G. Segalin. Moscow, State Publishers of Scientific-Technicological Mining Literature, 1960. 392p.

A review is given of the theoretical basis of radioisotope service in the coal industry. The design and construction of various devices for measuring and controlling bunker load and coal ash content, the automatic stabilization of clearing and cutting machines, automatic measuring of moisture and density, and the automatic control of floatation mills, mine air, etc., are described. (R.V.J.)

19701 RADIOAKTIVIYE IZOTOPY V PRIBOROSTROENII. (Radioactive Isotopes in Instrument Manufacturing). L. K. Tatochenko. Moscow, Atomizdat, 1960. 368p.

Theoretical and practical applications of radioactive isotopes in controlling and measuring devices and instruments for regulating technological parameters are described. Formulas are derived and methods are developed for calculating the performance of various instruments using radioactive transducers. (R.V.J.)

19702 RADIOPRESERVATION AND CONTAMINATION OF FOOD. BIBLIOGRAPHIC COMPILATION. U. Schützsack (Germany. Bundesforschungsanstalt fur Lebensmittelfrischhaltung, Karlsruhe). Nov. 15, 1960. 144p. (AED-BRD-C-05-1). (In German)

A bibliographic compilation is made of journal items, reports, and conferences relating to the radiopreservation and preservation of food. The 693 references are also tabulated according to report number, sponsoring institution, authors, and subject matter. (J.S.R.)

19703 RADIATION EFFECTS ON FOOD. BIBLIOGRAPHIC COMPILATION. Hans Lück (Germany. Forschungsanstalt fur Lebensmittelchemie, Munich). Nov. 15, 1960. 219p. (AED-BRD-C-02-2). (In German)

A bibliographic compilation is made of reports, conferences, journal items, and patents relating to the effects of radiation on food. The 1947 references are also tabulated according to report number, patent number, sponsoring institution, author, and subject matter. (J.S.R.)

ISOTOPE SEPARATION

19704 PRODUCTION OF LOW-TRITIUM DEUTERIUM. J. S. Drury, R. H. Guymon, and E. F. Joseph (Oak Ridge National Lab., Tenn.). Chem. & Process Eng., 42: 220-4 (May 1961).

A small, electrolytic facility for separating tritium from deuterium was designed and operated, and more than 400 kg. of deuterium oxide and about 70,000 N.T.P. liters of deuterium gas were purified. The average ratio of tritium to deuterium in the product was 6×10^{-18}. The purified deuterium can then be used in bubble-chamber experiments. (auth)

19705 STUDY OF THE ISOTOPIC EFFECT DURING THE ELECTROMIGRATION OF LITHIUM IN VITREOUS SILICA. Jules Pauly (Collège de France, Paris). Compt. rend., 252: 2407-9(Apr. 17, 1961). (In French)

The isotopic separation factor determined between 350 and 810° during the electromigration of Li^+ ions in a column of vitreous silica is close to the theoretical value, equal to the ratio of the square roots of the masses of Li^6 and Li^7. (tr-auth)

19706 URANIUM CONCENTRATION. Yoshitoshi Oyama (Tokyo Inst. of Tech.). Genshiryoku Hatsuden, 4: No. 3-4, 23-8(1960). (In Japanese)

A brief survey of the historical background and of the present status of the enrichment methods is given. Gaseous diffusion, centrifugal, and nozzle separation are considered of interest for application in Japan. The ideal and the squared-off cascade concepts are discussed for arriving at an economic evaluation of the U^{235} plant design. On the basis of cost calculations published by USAEC and the Saclay Nuclear Study Center, the economic bases of the gaseous diffusion method are given, including the estimation of the required capital investment and operating costs for plants installed in France and in Japan, comparing the estimated production costs with the U. S. data. Results indicate that the costs exceed the U. S. values by 50 to 90%. Groth and Zippe's data for UF_6 separation are included in a survey of the centrifuge method for isotope separation, comparing the power and capital costs with those required for the gaseous separation method, without drawing definite conclusions for lack of data. Leroy's survey on the nozzle separation method is expanded by including 20 additional references. Treatment of the jet stream and Becker's experimental data for UF_6 separation is discussed. (TTT)

19707 FRACTIONATION OF Li ISOTOPES IN THE REACTION OF METALLIC LITHIUM WITH ALKYL HALOGENIDES. W. Herzog (Max-Planck-Institut für Chemie, Mainz), W. Betz, and A. Neubert, Z. Naturforsch., 16a: 242-5(Mar. 1961). (In German)

In the reactions $\underline{n}$-$C_4H_9Cl + 2Li \rightarrow \underline{n}$-$C_4H_9Li + LiCl$ and $\underline{n}$-$C_4H_9Br + 2Li \rightarrow \underline{n}$-$C_4H_9Li + BiBr$, Li^6 is enriched in the LiCl or LiBr and Li^7 in C_4H_9Li. Benzene was used as the solvent. Investigation with early interrupted reactions gave a dependence of the fractionation on the reaction time. Studies with Li^6-labeled C_4H_9Li show that the reaction products exchange Li isotopes. The equilibrium effect measured for long reaction times was compared with the effect which can be calculated from the molecular vibration frequency of the Li halogenide and the hexamer C_4H_9Li. The larger fractionation in short reaction time can be explained both through a kinetic isotope effect and by a dependence of the equilibrium constants from the C_4H_9Li concentration as a result of the association of C_4H_9Li and the changes connected with the vibration frequencies. (tr-auth)

19708 CALCULATION OF ISOTOPE SEPARATION FACTORS IN ION EXCHANGE. D. A. Knyazev (Mendeleev Moscow Chemico-Technological Inst.). Zhur. Fiz. Khim., 35: 612-19(Mar. 1961). (In Russian)

A method was developed for calculating the isotope separation factors on ion exchange in strong electrolyte solutions. The calculated values of α are very close to those found experimentally. It is shown that ion exchange systems, including organic exchangers and strong electrolyte solutions, possess very low isotopic effects. Calculation has shown that the separation factor significantly depends upon the degree of cross-linkage of the exchanger and upon the nature and concentration of the electrolyte in the external solution. The separation of isotopes by ion exchange is shown to be the most efficient in the case of polyvalent ions of small mass. (auth)

19709 METHOD FOR THE SEPARATION OF GASES OR VAPOURS, AND PARTICULARLY OF ISOTOPES. (to DEGUSSA). Belgian Patent 551,429. Sept. 29, 1956.

Basically the separation is effected by diffusion of a vapor through a porous membrane. In order to eliminate as many pumps as possible, the raw material is used as a solid which is heated, and the vapor thus produced flows on its own through the separator. A proposed alternative is to condense the vapor after it has passed through the separator. These processes may be combined. (EURATOM)

19710 IMPROVEMENTS IN OR RELATING TO THE CONCENTRATION OF DEUTERIUM. (to Constructors John Brown Ltd.). British Patent 867,848. May 10, 1961.

A method of extracting and concentrating deuterium is described and illustrated. Two substantially immiscible molecular species, each of which contains at least one hydrogen atom, are used in the extraction. Hydrogen gas, hydrogen sulfide gas, and water may be employed as the first species with ammonia, water, and hydrogen sulfide as the second species, being in respective order with the first species. The method consists of passing a stream of the first species from which the deuterium is to be extracted through only the first (−40°C) of a system of three towers countercurrent to a stream of the second species. The stream of the second species is circulated thereafter in series through the second and third towers which are operated at −25°C and at 80° to 110°C respectively. A second stream of the first species is circulated through the second and third towers countercurrent to the second species, withdrawing a part of either species enriched in deuterium between the second and third towers. Withdrawal is compensated by adding a substantially equal molal quantity of the withdrawn species having a lower deuterium content. (N.W.R.)

MATHEMATICS AND COMPUTERS

19711 (BNL-631) PROGRAMS FOR IBM 610 COMPUTER TO PERFORM KURIE ANALYSIS OF BETA SPECTRA. B. D. Pate and D. J. Silvester (Brookhaven National Lab., Upton, N. Y.). Sept. 1960. 13p.

A series of programs for the IBM 610 computer for the analysis of beta spectrum data is described. The first program is used to calculate the ordinate and abscissa for a Kurie plot of an "allowed" beta group from pairs of intensity-magnetic rigidity data, Fermi function data, and screening correction data. The second program applies a "unique-first-forbidden" correction to the data from Program 1 using a trial end-point energy value to be supplied. Program 3 performs least-squares analysis of Kurie plot data from Program 1 of 2. Program 4 subtracts beta-group intensity from the total observed intensity. The fifth program recalculates, using Kurie plot parameters, the intensity as a function of momentum. Program 6 applies a decay correction to a series of Kurie ordinate values. (M.C.G.)

19712 (CEND-130) CRUMB-2—A ONE POINT, FOUR GROUP REACTOR BURNUP CODE FOR THE IBM-7070. Study of Slightly-Enriched Uranium-Water Lattices with High Conversion Ratio. C. J. Hansen (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). May 1961. Contract AT(30-1)-2379. 35p.

CRUMB-2 is an IBM-7070 computer code designed to provide an inexpensive means of investigating the nuclear characteristics of uniform mixtures of fuel, water, and structural materials throughout burnup life. The computations are done in a four energy group scheme which utilizes an in-program library of fast microscopic constants. The output provides a large amount of data applicable to parameter studies of burnup characteristics. (auth)

19713 (CF-61-3-1) PREPROCESSING OF PROCEDURES IN THE ORACLE-ALGOL TRANSLATOR. L. L. Bumgarner (Oak Ridge National Lab., Tenn.). May 15, 1961. 20p.

The preprocessing stage to be added to the present ORACLE-Algol translator which will enable it to translate programs containing procedures is described. The preprocessor replaces procedure declarations and procedure statements by declarations and statements which can be handled by the present translator with a few additions. (M.C.G.)

19714 (HW-68806) VTΘCL—A 709 PROGRAM FOR REDUCTION OF EXPONENTIAL PILE DATA. D. D. Matsumoto (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1961. Contract AT(45-1)-1350. 25p.

The uses, method of analysis, and input requirements of VTΘCL, a 709 program for reduction of exponential pile data are described. VTΘCL is a revision of a previous code, to which additional options were added. The principal purpose of the code is the computation of material buckling by means of a least squares fit on vertical traverse data taken in an exponential pile. The program may also be used to produce only end or harmonic corrections. The third possible use has as end product the normalized values of thermal flux computed from vertical traverse data. (M.C.G.)

19715 (KAPL-M-NPA-22) BHT3: AN S-2000 (TRANSAC) DIGITAL COMPUTER PROGRAM TO CALCULATE BOILING HEAT TRANSFER OF STEAM GENERATORS. H. Harden (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 15, 1961. Contract W-31-109-Eng-72. 28p.

BHT3 is a means of rapidly performing calculations of steam generator heat transfer performance in which boiling occurs on the outer surface of tubes and forced convection occurs on the inside. Further, it only applies to steam generators which can be adequately described by an average tube representation. Primary loop average temperature, loop weight flow, and fraction of nominal heat rate are program input, along with nominal heat rate, primary pressure, steam generator diameter, tube diameter, and length and number of tubes. The following temperatures are program output: secondary steam saturation temperature, hot leg temperature, cold leg temperature, and ΔT. (auth)

19716 (KAPL-M-RPC-1) TRAM FOR THE PHILCO-2000. R. A. Pfeiffer and W. W. Stone (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 24, 1961. Contract W-31-109-Eng-52. 40p.

TRAM is a three-dimensional neutron transport program for the Monte Carlo determination of spatial and spectral variations of the neutron population below 100 ev and is for use with the Philco 2000. The program is a rewrite of the 704 program with provision for larger problems and more flexible geometries and includes a simplified input preparation scheme with extensive program checking for input errors and diagnostic printouts. Its principal application is in the calculation of proportionate captures in the various regions of a reactor cell. (D.L.C.)

19717 (MLM-1109) EXPANSION OF A 2×2 LATIN SQUARE INTO A $2 \times 2 \times 2$ FACTORIAL EXPERIMENT: A STUDY IN METAL DISTILLATION. M. K. Barnett (Mound Lab., Miamisburg, Ohio). May 17, 1961. Contract AT-33-1-GEN-53. 21p.

The advantages of a sequential experimental plan, involving fractional replication of a factorial experiment followed by expansion into a full replicate, are illustrated by a study in metal distillation. A small amount of a metal (B) was to be recovered from a relatively large amount of a second metal (A). The efficiency of separation was regarded as a function of three controlled operating temperatures: the temperature of the liquid metal; the temperature at a control point in the still column; and the temperature near the top of the still. The results were interpreted by regarding the distillation as a two-stage process, consisting of vaporization of metal B from the melt, followed by transporation of the vapor through the column and condensation on the collector. A 2×2 Latin Square devoted to the three temperature factors provided tentative measures of the effects and established the over-all feasibility of the study. Expansion of the square into a $2 \times 2 \times 2$ factorial experiment gave more reliable measures of the effects. Discrepancies between the Latin Square effects and the main effects of the factorial were readily correlated with interactions between the factors. (auth)

19718 (NAA-SR-Memo-5954) FARSE-1A. A MODIFICATION OF FARSE TO INCLUDE ANGULAR DEPENDENCE OF SHIELD LEAKAGE. K. L. Rooney (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 9, 1960. 44p.

The FARSE code, a IBM-7090 code developed for evaluating the neutron leakage from a shield annulus, was modified to include the angular distribution of the leakage current. (D.L.C.)

19719 (NAA-SR-Memo-6078) HAMBONE—A MONTE CARLO CODE TO EVALUATE NEUTRON SCATTERING FROM CYLINDRICAL FUEL RODS. W. J. Roberts and K. L. Rooney (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 27, 1961. 38p.

An experimental program was set up at the L-77 facility to correlate the atom concentration of hydrogen in the SDR fuel rods with thermal neutrons scattered from these rods as measured by a collimated BF_3 chamber. HAMBONE was written to evaluate the same variation of thermal neutron scatter with N_H of fuel rod by means of Monte Carlo techniques to interpret the experiments and to act as a secondary standard for future determination of fuel element hydrogen content. The code computes thermal neutron histories of the neutrons from a mono-directional Maxwelliam source impinging on a fuel rod. The number of hits for a given sample is then used as a measure of the hydrogen content of elements. Case histories are generated at a rate of 1,000 per min. With target biasing or at 7,000 per min. with random deposition. (auth)

19720 (NP-10271(p.12-19)) AN INTERPRETIVE PROGRAM FOR THE TREATMENT OF MULTICHANNEL DATA ON THE NAREC. P. R. Malmberg (Naval Research Lab., Washington, D. C.).

Both the 100-channel and the 256-channel pulse-height analyzers were adapted to transcribe the contents of their memories onto punched paper tape in a form suitable to read directly into the NAREC. An interpretive program for the treatment of multichannel data on the NAREC is described. Besides pulse-height data, it may also be applied to certain matrix operations and other coding problems. (N.W.R.)

19721 (NYO-9494) ALTERNATING DIRECTION AND SEMI-EXPLICIT DIFFERENCE METHODS FOR PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS. Milton Lees (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Mar. 1, 1961. Contract [AT-(30-1)-1480]. 34p.

The energy method is applied to study the stability of two types of difference approximations to parabolic partial differential equations, the alternating direction methods Douglas, Peaceman, and Rachford, and a new semi-explicit method. Each difference scheme is proved to be unconditionally stable. These results apply to parabolic equations with variable coefficients, defined in cylindrical domains with an essentially arbitrary bounded base. (auth)

19722 (SCR-400) THE USE OF AN ASSEMBLER (SAP)[1] AS A LOGICAL DECISION MAKER. C. M. Williams (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 7p.

A study was made to determine whether the logic of optimization of computer memory and execution time can be automatically and efficiently done by existing and relatively unsophisticated systems. SAP, a machine language assembly routine for the IBM 704, was used as the assembler. The theory and applications of the program are discussed. It is shown that it is possible to construct a decision making device from a simple arithmetic calculator, provided only that division by zero is defined. It is also shown that the assembler may produce an object deck which is optimally efficient in terms of the amount of memory it requires and in the time necessary for its execution. (M.C.G.)

19723 (SCR-405) SOME USEFUL APPLICATIONS OF ORED INDEX REGISTERS. C. M. Williams (Sandia Corp., Albuquerque, N. Mex.). May 1961. 8p.

Presented at the Association for Computing Machinery, University of New Mexico, Albuquerque, New Mexico, April 1960.

Examples are presented to show how ORed index registers can provide short, efficient, and, in some cases, more straightforward methods for doing certain jobs than more normal coding will allow. Efficiency is gained not only because masking is nondestructive, but because masking and use of the extracted bits may be done in one instruction at no extra cost in time. A simplified procedure for indexing arrays, masking, a fast method for using tabular values randomly, a simple symbol manipulation technique, decimal arithmetic in a binary machine, efficient program flow control, and an efficient method for counting ones are discussed. (M.C.G.)

19724 (TID-11822) FORTRAN II FUNCTION SUBROUTINES FOR CLEBSCH-GORDAN AND RACAH COEFFICIENTS. T. J. Kostigen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 15, 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 15p. (XDC-61-1-102).

FORTRAN II function subroutines were coded for Clebsch-Gordan, Racah, and Z-coefficients to be used in nuclear reaction theories. (auth)

19725 (TID-12716) COMPUTER PROGRAM 0641—DIFFUSION CURRENT FOR EACH ISOTOPE IN A FOUR-MEMBER DECAY SCHEME FROM AN ARRAY OF BARE SLABS. J. L. McGurn and J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 1, 1960. Contracts AT(11-1)-171 and AF33(600)-38062. 15p. (XDC-61-3-87).

GE-ANPD Computer Program 0641 may be used to evaluate the radioisotope volume diffusion current at the surface of a bare slab, in a parallel array of slabs, in each of which the fission point density is uniform. These slabs are assumed to be separated by a fluid layer. The current, (J) the time integral of J, and the space integral of the radioisotope concentration are evaluated as functions of time for each of the isotopes in a four-member decay scheme. The effect of fission fragment recoil escape into the fluid layer and re-entry build-up due to fragments which traverse this layer is accounted for in the description of the direct fission source term for each isotope. Program 0641 can be used on either the IBM 704 or the IBM 7090 computer. (auth)

19726 (TID-12727) FLEXIBLE MONTE CARLO SOURCE GENERATOR. J. J. Loechler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 20, 1961. Contracts AF 33(600)-38062 and AT(11-1)-171. 21p. (XDC-61-4-52)

Flexible Monte Carlo Source Generator (GE-ANPD Program 707) is a digital computer program which applies Monte Carlo methods to generate the seven parameters required to describe each FMC source particle. The program stores these parameters on magnetic tape for later analysis and processing by the FMC programs. The program is coded in FAP for an IBM-7090 computer with a 32-K fast memory capacity and two data channels using tape units A-1, A-2, A-3, B-5, and B-6. (auth)

19727 (TID-12739) A MECHANIZED METHOD FOR THE CALCULATION OF SPATIAL RESONANCE SELF-SHIELDING FACTORS IN SLAB GEOMETRY. F. P. Karriker (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 3, 1961. Contracts AF 33(600)-38062 and AT(11-1)-171. 21p. (XDC-61-4-17)

A FORTRAN-II coded calculation is described of the spatial resonance self-shielding factors of heavily absorbing slabs immersed in an isotropic neutron flux. The behavior of the neutrons within the slab is handled by first-collision probability theory, and the energy dependency of

the resonance cross sections is assumed to be given by the folding of a single level Breit-Wigner resonance into a Maxwellian. The integration over the possible paths of passage of the neutrons through the slab is done analytically, but the integration over the energy span of the resonance has to be done numerically. The assumption is tacitly made that the peak resonance energy is much larger than the half-width of the resonance; so that one can take $\Delta E \ll E_0$, and the Doppler width parameter θ to be essentially constant for each resonance. (auth)

19728 (WAPD-TM-255) BAFL-1—A PROGRAM FOR THE SOLUTION OF THIN ELASTIC PLATE EQUATIONS ON THE PHILCO-2000 COMPUTER. J. B. Callaghan, P. H. Jarvis, and A. K. Rigler (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1961. Contract AT-11-1-GEN-14. 34p.

A description is presented of BAFL-1, a Philco 2000 computer program for calculating small deflections of thin rectangular plates. The problems are approximated by a uniform mesh of up to 1600 points. Boundary conditions allow each of the four sides to be either clamped, simply supported, symmetric (floating clamp), or free. The plate loading may be a combination of a uniform load and pointwise loads. (auth)

19729 (WAPD-TM-274) THE TWO-DIMENSIONAL, QUADRUPOLE P_0 AND P_1 APPROXIMATIONS. R. C. Gast (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. 42p.

A new formulation of the quadruple P_0 and P_1 equations in two dimensions is given which, unlike previous formulations, will satisfy the requirement that a reduction to slab geometry, by integration over lines parallel to one of the coordinate axes, will produce the usual double P equations with conical symmetry in the vector flux. Solutions of some elementary problems for cylindrically symmetric systems are obtained which indicate, in some cases, a severe lack of cylindrical symmetry and hence suggest limitations in the applicability of a quadruple-P approach. (auth)

19730 (AEC-tr-4538) STATISTICAL SAMPLING INSPECTION PROCEDURES. V. Horalek. Translated from Strojirenstvi, 4: 849-53(1954). 17p.

A survey is presented of quality control acceptance sampling methods together with certain applications and a discussion of practical experience obtained in the use of the methods. (B.O.G.)

19731 (UCRL-Trans-643) DETERMINATION OF A DIFFERENTIAL EQUATION BY ITS SPECTRAL FUNCTION. I. M. Gelfand and B. M. Levitan. Translated from Doklady Akad. Nauk S.S.S.R., 77: 557-60(1951). 11p.

The problem of determining whether an equation of the type $y'' + (\lambda - q(x))y = 0$ has a monotonic function $p(\lambda)$ as its spectral function is treated. The converse case, that of determining whether an equation exists for a given $p(\lambda)$, is also considered. The results are used to study the spectral functions of Sturm-Liouville's classical problem. (D.L.C.)

19732 TABLES OF THE HYPERGEOMETRIC PROBABILITY DISTRIBUTION. Gerald J. Lieberman and Donald B. Owen. Stanford Studies in Mathematics and Statistics. III. Stanford, Calif., Stanford University Press, 1961. 731p. $15.00.

The hypergeometric probability distribution is tabulated for a wide range of values. The correlation between hypergeometric distribution and exceedance theory is shown. A table of (log N!) values is provided. (T.F.H.)

19733 A FORTRAN PROGRAM FOR ELASTIC SCATTERING ANALYSIS WITH THE NUCLEAR OPTICAL MODEL. Michel A. Melkanoff (Univ. of California, Los Angeles), John S. Nodvik, David S. Saxon, and David G. Cantor. University of California Publications in Automatic Computation No. 1. Berkeley and Los Angeles, University of California Press, 1961. 116p. $4.50.

A FORTRAN code (SCAT-4) analyzes elastic scattering of various particles by complex nuclei, using the diffuse surface optical model potential with variable parameters. The total cross section, differential scattering cross section, and the polarization as a function of scattering angle are calculated. The incident particle may have spin 0 or $\frac{1}{2}$, and any mass, charge, and non-relativistic energy. The scattering nuclei are spinless, and may have any mass and charge. (T.F.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

9734 (HW-68182(Pt.1)) METALLOGRAPHIC STUDIES F REACTOR GRAPHITE MATERIALS. PART I. COKES. . J. Clark (General Electric Co. Hanford Atomic Products peration, Richland, Wash.). Feb. 10, 1961. Contract T(45-1)-1350. 26p.

Metallographic studies of petroleum cokes are useful in valuating the cokes for use in reactor electrographites. formation about the structure and composition of the cokes as obtained and the effects of coking and calcining are scussed in terms of shrinkage and cracking. Photographic esults are presented for a number of cokes currently of terest in the manufacture of reactor electrographites. uth)

9735 (KAPL-2145) CONDUCTIVITY IN AGGREATES. A. E. Powers (Knolls Atomic Power Lab., Schectady, N. Y.). Mar. 6, 1961. Contract W-31-109-Eng-2. 38p.

A survey was made of methods and equations for calcuting the conductivity of aggregates of almost any type. he various equations were correlated and classified acording to the basic assumptions concerning the nature of e aggregate. Derivations are presented so that the apicability of the equations may be more easily understood, nd the nature of these relations is shown by the use of raphical examples. Conductivity in aggregates containing pherical, nonspherical, and coated spheres is treated uantitatively. (auth)

9736 (LA-2521) PREPARATION OF MINUS 10 ICRON DENSE UO_2. M. C. Tinkle, W. J. McCreary, . D. Travis, R. J. Bard, and J. A. Kircher (Los Alamos cientific Lab., N. Mex.). July 1960. Contract W-7405-NG-36. 21p.

A 100%-yield process was developed for the preparaon of relatively free-flowing dense UO_2 powder with less an 0.01 wt.% + 325 mesh, no +10 micron particles deectable with a Sartorius Sedimentation Balance, less than) wt.% – 2 microns, loose bulk density of about 4 g/cm^3, nd particle density of about 10.9 g/cm^3 by He displaceent. This UO_2 powder can be prepared by simple steps ot involving classification. (auth)

9737 (NAA-SR-6094) SODIUM–GRAPHITE INTERCTION AND GRAPHITE PROTECTIVE COATINGS. J. J. ill (Atomics International. Div. of North American Aviaon, Inc., Canoga Park, Calif.). May 1, 1961. Contract T-11-1-GEN-8. 23p.

Molten sodium attacks artificial graphites, causing dilaon and, under some conditions, decrepitation. Because of ne anisotropy of extruded graphite, dilation perpendicular o the extrusion axis is slightly greater than parallel to ne extrusion axis. At 600 to 1000°F, sodium is initially onwetting to graphite, but becomes wetting in a matter of inutes. The liquid soaks into the pores of the graphite rough chemisorption and intergranular penetration; inerlamellar compounds or complexes may also be formed. oatings and coating techniques were investigated for the rotection of graphite from attack by molten sodium. The oatings examined included chromium, nickel, zirconium, irconium carbide, tungsten carbide, silicon carbide, sili-on nitride, and molybdenum disilicide. None of the coatngs, tested by soaking in static sodium at 1000°F, gave atisfactory protection. Failure in all cases resulted from continuous porosity or cracks in the coating material. (auth)

19738 (NAA-SR-Memo-5907) UNCLASSIFIED LITERATURE SURVEY ON THE RECLAMATION OF ZIRCONIUM AND ZIRCONIUM ALLOY SCRAP. R. G. Middleton (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 11, 1960. 18p.

It is noted that no satisfactory Zr decontamination method has been developed, however methods such as nitric-hydrofluric pickling, sulfuric acid pickling, and molten or vaporous calcium deoxidation appear to be the most promising. Molten Zr, Ti, and U reactions on various ceramics indicated reaction mechanisms and expected contaminants. Recommendations for further investigations are included. (J.R.D.)

19739 (NMI-7200) EVALUATION OF ZIRCALOY-CLAD UNALLOYED URANIUM TUBES MADE FOR IRRADIATION IN THE VBWR TEST LOOP. W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Apr. 25, 1960. Contract AT(30-1)-1565. 38p.

Data obtained in the evaluation of Zircaloy-clad unalloyed uranium tubes Nos. 68 and 69, extrusions Nos. 23165 and 23166 are presented. The tubes were fabricated for irradiation testing in the Vallecitos Boiling Water Reactor. The evaluation data, presented primarily in the form of tables, show that the tubes meet the minimum irradiation specifications in all characteristics except the minimum clad thickness and, as a result, the maximum core thickness. This deviation is due to the gradual thinning of the inner cladding from the ends toward the center of the uniform core. (M.C.G.)

19740 (NMI-7201) EVALUATION OF ZIRCALOY-2-CLAD UNALLOYED URANIUM TUBE NO. 72 MADE FOR IRRADIATION TESTING IN NRU. W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). Dec. 21, 1960. Contract AT(30-1)-1565. 33p.

Data obtained in the evaluation of Zircaloy-2-clad unalloyed uranium tube No. 72, extrusion No. 27325 are presented. This tube was fabricated to provide test material for irradiation in the NRU Reactor. The evaluation data, presented primarily in the form of tables, show that the tube meets irradiation specifications in all characteristics except the minimum cladding thickness in the taper region. A low-power binocular examination in this area revealed only minor surface irregularities. (M.C.G.)

19741 (NMI-7203) EVALUATION OF ZIRCALOY-4-CLAD UNALLOYED URANIUM OUTER TUBE NO. 75, EXTRUSION NO. 27943 MADE FOR IRRADIATION AT SAVANNAH RIVER. H. F. Sawyer (Nuclear Metals, Inc., Concord, Mass.). Dec. 14, 1960. Contract AT(30-1)-1565. 36p.

Data obtained in the evaluation of a Zircaloy-4-clad unalloyed uranium outer tube No. 75, extrusion No. 27943. Billet design, component identities and analyses, preparation of components and assembly of billets, extrusion, beta heat treatment, other post-extrusion operations, and autoclaving are discussed. Data and test results are presented in graphical form. (M.C.G.)

19742 (NMI-7207) EVALUATION OF ZIRCALOY-4 CLAD-UNALLOYED URANIUM INNER TUBE NO. 105 MADE FOR FLOW-TESTING AT SRP. W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Dec. 2, 1960. Contract AT(30-1)-1565. 33p.

Data obtained in the evaluation of Zircaloy-4-clad unalloyed uranium inner tube No. 105, extrusion No. 29311 are presented. This tube is one of a lot of three prototype inner thin-walled tubes fabricated to provide test material for irradiation at SRP. The evaluation data, presented in the form of tables, show that tube 105 meets irradiation specifications in all characteristics. This tube was not heat treated since it is intended only for use in flow-testing. (M.C.G.)

19743 (NP-10087) PYROPHOSPHATE PLATING SOLUTIONS. An Annotated Bibliography. Robert C. Gex, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Mar. 1961. 19p. (SB-61-8).

The literature was searched for articles on pyrophosphate solutions used in metal plating. The solution contains the pyrophosphate radical, $P_2O_7^{4-}$, and a metal, usually sodium or potassium. 60 references were found for plating primarily copper, but also brass, cobalt, iron, lead, magnesium, nickel, steel, and zinc. The arrangement is alphabetical by author. An index is included for metals and plating solutions. (auth)

19744 (NP-10278) DEVELOPMENT OF A NICKEL-BASE MATERIAL DISPERSION-HARDENED BY ALUMINA FOR 1600°F TO 2000°F SERVICE. Final Report, January 6, 1959 through November 6, 1960. D. H. Feisel (Westinghouse Electric Corp. Research Labs., Pittsburgh). Dec. 6, 1960. Contract NOas-59-6051-C. 271p.

The chemical, physical, and mechanical properties of a number of nickel-base dispersion-hardened alloys were extensively studied. A technique involving partial oxidation of active Raney nickel catalyst was employed to attain a dispersion of aluminum oxide in the matrix. The matrix compositions of the alloys were grouped into four classes: nickel, nickel solid solution, nickel solid solution + $Ni_3(Al, Fe)$, and $Ni_3(Al, Fe)$. Data are presented for techniques of preparation, alloy composition, density, hardness, oxidation resistance, tensile strength, compressive strength, stress-rupture strength, and compressive creep strength. (auth)

19745 (TID-7602(Pt.I)(p.29-38)) RESEARCH ON BERYLLIUM OXIDE AND FUELED BERYLLIUM OXIDE AT THE OAK RIDGE NATIONAL LABORATORY. W. O. Harms (Oak Ridge National Lab., Tenn.).

Several techniques for preparing high-purity BeO were evaluated: (1) calcination of hydrated BeC_2O_4, (2) solvent extraction with CCl_4 solutions of acetylacetone, and (3) precipitation from fluoride melts. In (2), separation factors were determined for a large number of metals using an aqueous phase of 0.12M in disodium EDTA. In (3), the precipitation of UO_2 particles coated with BeO was studied. Studies of phase relationships in BeO–metal oxide systems were carried out. In the BeO–CaO system, a low-viscosity, unstable liquid containing ~40 mole% CaO was found to form at ~1350°C. The eutectic temperatures of the BeO–MgO and BeO–CeO_2 systems were determined to be 1860 ± 20 and 1775 ± 20°C, respectively. Irradiation data on BeO indicate no visible changes except slight discoloration from metal capsules. The sinterability of BeO powders derived from BeC_2O_4 was evaluated; sinterability variations were found, and phase changes in the calcination process at temperatures up to 900°C were studied. It was found that $BeC_2O_4 \cdot H_2O$ is the only stable intermediate compound formed during calcination and that a liquid phase forms in the range 80 to 150°C during continuous heating. BeO bodies containing 30 vol % UO_2 or UO_2–ThO_2 were fabricated to 95% theoretical density. With readily sinterable UO_2 powders, these bodies could be sintered in H_2. However, with less sinterable UO_2 powders, it was necessary to maintain a high O/U ratio in Ar during the sintering cycle to prevent cracking; the O/U ratio was then lowered by introducing H_2 in the last ½ hr of sintering. Preliminary examination of BeO bodies containing 30 vol % UO_2 particles of size 150 to 250 μ indicates that the formation of sound bodies requires a preliminary shrinking of the fuel particles. (D.L.C.)

19746 (TID-7603(p.52-4)) DEVELOPMENT OF URANIUM CARBIDE PRODUCTION PROCESS AT MALLINCKRODT NUCLEAR. C. W. Kuhlman (Mallinckrodt Chemical Works. Nuclear Div., [Hematite, Mo.]).

A commercial process for UC and/or UC_2 that could use available standard equipment was developed. Preliminary explorations indicated that a method using carbon reduction of UO_2 would yield the best product at the lowest cost. In the process developed, after ball-milling, weighed quantities of UO_2–C are pressed into pellets and the pellets fired in a carbon resistance furnace at 1800 to 1900°C. An argon atmosphere is used for storage of the pellets. (M.C.G.)

19747 (TID-7603(p.127-9)) PROGRESS IN TECHNOLOGY OF COLUMBIUM-ALLOY CLAD URANIUM CARBIDE FUEL ELEMENTS AT UNION CARBIDE METALS COMPANY. M. Korchynsky (Union Carbide Metals Co., Niagara Falls, N. Y.).

The advantages and disadvantages of the production of UC by the uranium-methane reaction are discussed. Techniques in the fabrication of UC by powder-metallurgical methods are outlined. The use of niobium alloys as cladding materials is discussed. (M.C.G.)

19748 (TID-7603(p.130-46)) THE PREPARATION OF URANIUM MONOCARBIDE BY REACTION SINTERING AT A.E.R.E., HARWELL. H. J. Hedger and C. M. Regan (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Factors affecting the density and porosity of UC formed by uranium–graphite mixtures heated to 1100°C were investigated. The effect of additions which form a liquid phase was also studied. A –300 mesh uranium powder and very finely ground graphite were used. Alcohol was added to facilitate mixing, but the bulk of the liquid was allowed to evaporate before compacting. The progress of the reaction was studied by quenching specimens heated for various times at temperatures of 800 to 1100°C. The studies indicated that a liquid phase is desirable to reduce the amount of diffusible porosity. The higher densities obtained with the addition of VF_2 were believed to be due to its being the most favorable additive for forming a wide range of fusible mixtures, while allowing gas to escape during the early stages of reaction. (M.C.G.)

19749 (TID-12441) FIRST QUARTERLY REPORT ON THE PRODUCTION OF URANIUM CARBIDE AND MIXED CARBIDES, AS ALSO OF CERMETS MANUFACTURED FROM URANIUM CARBIDE; INCREASE IN THE RESISTANCE TO CORROSION AND THE EXAMINATION OF THE PROPERTIES OF THESE PRODUCTS. Period Covered May 1–July 30, 1960. Paul Himmelstein and Bernhard Liebmann (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). AEC 150/EURATOM 198. 6p.

Work was done on developing a method for producing UC by the processes of combustion by reaction and fusion in arc furnaces. Tests for producing sub-stoichiometric UC showed that it is possible to produce uranium and UC cermets in an arc furnace from mixtures of UO_2 and graphite. A table is given of the carbon content and specific weights

of samples produced, which shows the degree of precision possible for obtaining the desired chemical composition. The production of UC powder by grinding is discussed. (B.O.G.)

19750 (TID-12443) SECOND QUARTERLY REPORT ON THE PREPARATION OF URANIUM AND MIXED CARBIDES AND OF UC-CERMETS, IMPROVED RESISTANCE TO CORROSION AND INVESTIGATION OF THE PROPERTIES. Period Covered: August 1–October 31, 1960. Paul Himmelstein and Bernhard Liebmann (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). AEC 150/EURATOM 198. 11p.

A device is described which permits the transfer of a powdery mixture of carbon and UO_2 from a storage container to an electric arc for the continuous production of UC. The rate of fusion was found to be 70 to 100 g of UC/hr, while another 20 to 30 g was blown away as unconverted powder by the blast of CO produced in the reaction. Microhardness values were determined for two hypo-stoichiometric uranium carbides, $UC_{0.3}$ and $UC_{0.5}$, for the carbide and metal phases. (B.O.G.)

19751 (TID-12610) NICKEL–CHROMIUM–IRON ALLOY PLATE, SHEET AND STRIP; CORROSION RESISTING, FOR RADIOACTIVE SYSTEM SERVICE. C. F. Barrett, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 4, 1958. Contract W-31-109-Eng-52. 12p. (KAPL-Spec.-KPM3-47)

A set of specifications is presented for the production of Cr–Fe–Ni alloy plate, sheet, and strip materials in standard annealed conditions for use in radioactive systems. (B.O.G.)

19752 (TID-12714) THERMAL STRESSES IN LONG RECTANGULAR PLATES. Arthur L. Ross (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 28; 1960. Contracts AF 33(600)-38062 and AT(11-1)-171. 5p. (XDC-61-2-115)

The general thermal stress solution for a long rectangular plate whose temperature is independent of the length is derived. This solution goes beyond the well known, and generally available, solutions in that it includes the effect of variation in the modulus of elasticity as well as the thickness and coefficient of thermal expansion. (auth)

19753 (TID-12748) SINGLE CRYSTALS OF SODIUM AND LITHIUM METALS. Report No. 3. R. Bowers, D. Pinnow, and S. Tallman (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Mar. 13, 1961. Contract AT(30-1)-2150. 21p.

A description is given of growing single crystals of lithium and sodium using the Bridgman and Czochralski methods. Etching, cutting, and orientation techniques are discussed. (auth)

19754 GAS- AND LIQUID-IMPERMEABLE GRAPHITE FOR REACTOR CONSTRUCTION. E. Fitzer, O. Vohler, and K. W. F. Etzel (Siemens-Planiawerke AG für Kohlefabrikate, Meitingen, Ger. and Farbwerke Hoechst, Werk Griesheim, Frankfurt am Main). Atomkernenergie, 6: 137-51(Apr. 1961). (In German)

The possibilities of making graphite impermeable to gases and liquids are shown. The physical properties of the impermeable graphites depend on the different sealing processes. For such methods special starting materials were developed. In the development of reactor grade graphite, as described in a previous article, Germany was quite behind other countries. As far as making impermeable graphite is concerned, however, developments and experiences were gained in manufacturing impermeable materials for the chemical industry. The liquid- and the gas-impregnation methods are discussed principally. The problems of sealing and the degree of impermeability which can be obtained are pointed out using different measuring techniques. Finally, a description is given of "pyrographite", a newly discovered old graphite material. (auth)

19755 PREPARE THORIUM–ALUMINUM ALLOYS... BY DIRECT REDUCTION. Douglas O. Raleigh (Atomics International, Canoga Park, Calif.). Ind. Eng. Chem., 53: 445-8(June 1961).

A process is described for preparing Th–Al alloys by directly reducing ThO_2 with aluminum. Alloys of at least 20% (weight) thorium content can be prepared with near-quantitative yields; alloys up to 40% (weight) thorium can be produced. A ThO_2-cryolite mix is heated with aluminum for 0.5 hour at 1050°C. Optimum reduction yields of 97% occur with a feed mix of 25% ThO_2–75% cryolite. Reaction rate is relatively independent of ThO_2 particle size but increases with inductive stirring in the melt. The major driving force for reduction is a large free energy of formation for $ThAl_3$. Sodium is produced as a possibly useful by-product. Economics and scale-up feasibility appear promising. (auth)

19756 PREPARING PLUTONIUM METAL VIA THE CHLORIDE PROCESS. M. J. Rasmussen and H. H. Hopkins, Jr. (General Electric Co., Richland, Wash.). Ind. Eng. Chem., 53: 453-7(June 1961). (HW-66128; HW-SA-1969)

The chloride process was developed to decrease personnel exposure from the high neutron flux of plutonium fluorides. Neutron radiation from $PuCl_3$ measured $\frac{1}{64}$th that from PuF_4. In continuous operation the plutonium was precipitated as oxalate, filtered, calcined at 300°C to oxide, then chlorinated with phosgene at 500°C. The chlorination rate was 250 grams of plutonium per hour. The $PuCl_3$ was reduced by calcium in heated pressure vessels. Yields were 97% as pure plutonium metal solidified as buttons in the bottom of the reusable crucibles. Plutonium-bearing dusts were filtered from the chlorinator off-gas stream by heated ceramic filters. Chloride powders did not hydrate in the dry atmosphere of dew point –20°C. Corrosion was controlled by dry atmosphere and by use of selected plastics and metals. (auth)

19757 REDUCTION OF NIOBIUM-OXYGEN SOLID SOLUTIONS BY ALKALINE EARTH METALS. O. Kubaschewski (National Physical Lab., Teddington, Eng.). J. Inst. Metals, 89: 295-6(Apr. 1961).

Solid solutions of oxygen in transition metals, in the form of small tubes of 0.055 mm wall thickness and 3 mm dia., were equilibrated with Ca, Mg, or Ba, in bombs made of, or lined with, the respective transition metal. After equilibration, the contents of the bombs were leached in dilute HCl, the composition of the products determined by chemical and vacuum-fusion analyses, and the free energies of solution of oxygen in the solid solutions calculated from the known free energies of dissociation of the alkaline earths. It is obvious that new methods must be found. There is still a gap in oxygen potential that cannot be studied by the above methods. (P.C.H.)

19758 THE PILOT PLANT PRODUCTION OF ELECTROLYTIC URANIUM DIOXIDE. J. R. Chalkey (Impregnated Diamond Products, Ltd., Gloucester, Eng.). J. Less-Common Metals, 3: 98-109(Apr. 1961). (In English)

The electrolyte, containing uranyl chloride dissolved in

molten NaCl/KCl eutectic, is obtained by the direct chlorination of uranium oxide in situ in the fused salt, and electrolysis between graphite electrodes forms a crystalline deposit of UO_2 at the cathode. The deposition is carried out with either horizontally or vertically disposed electrodes, but the latter are preferred from the point of view of simplicity. An alternative process, using uranium ore concentrate as the starting material and involving three electrolytic stages is also described. The bulk of the impurities are removed in the first electrolysis in which anodic chlorination is used to improve the efficiency of the stage. The product, 99% pure, is treated in the same way as the pure oxide starting material, but a third electrodeposition, in which the UO_2 plated cathode is used as a soluble anode, is necessary to achieve the purity level required for nuclear fuel applications. The impurities found in the product are discussed in the context of their origin and their behavior in the process, particular reference being made to the rare earths. The process is capable of producing oxides within the range of composition UO_2 to $UO_{2.5}$. Conditions affecting this variation are described. (auth)

19759 AN APPLICATION OF X-RAY FLUORESCENT SPECTROGRAPHY TO COLUMBIUM ALLOY MELTING PRACTICES. D. Moroz, D. E. Fornwalt, S. Aconsky, J. Doyle, and W. R. Clough (Pratt and Whitney Aircraft, Middletown, Conn.). p.495-512 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

Techniques were developed and statistically evaluated for the determination of the homogeneity and the elemental compositions of Nb alloy ingots. Sample preparation is discussed in detail from the consumable-electrode arc-melt process to the final physical form suitable for x-ray fluorescent spectrography. Arrangements of apparatus for obtaining, recording, processing, and interpreting data, with specific attention to limitations for various matrices, are treated at length. The method was applied to specific cases with, for example, a correlation of the degree of variation of homogeneity of Nb alloy ingots with remelting practice. An attempt is made to provide a preliminary basis for determining the value of the technique as a possible means of quality control. (auth)

19760 THORIUM: PRODUCTION AND PROPERTIES OF THE ELEMENTS. BIBLIOGRAPHIC COMPILATION. (Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main). Dec. 20, 1960. 199p. (AED-BRD-C-08-1). (In German)

A bibliographic compilation is made of reports, conferences, journal items, books, dissertations, and patents relating to the production and properties of thorium. The 856 references are also tabulated according to report and patent numbers, sponsoring institutions, and authors. (J.S.R.)

19761 PREPARATION OF LOW OXYGEN CONTENT NIOBIUM AND TANTALUM. (to CIBA, S. A.). Belgian Patent 578,034. Oct. 23, 1959.

Ductility of these metals being seriously affected by oxygen, niobium or tantalum powder is heated in a hydrogen atmosphere at a temperature between 600 and 1200°C. A hydrogen-generating electrolytic bath can also be used; dehydrogenation is obtained by heating under inert gas, vacuum, or hydrogen. (EURATOM)

19762 ELECTROLYTIC PROCESS FOR PRODUCING METALS. B. Kopelman and R. B. Holden (to U. S. Atomic Energy Commission). U. S. Patent 2,987,454. June 6, 1961.

A method is described for reducing beryllium halides to beryllium. The beryllium halide is placed in an eutectic mixture of alkali halides and alkaline earth halides. The constituents of this eutectic bath are so chosen that it has a melting point less than the boiling point of mercury, which acts as a cathode for the system. The beryllium metal is then deposited in the mercury upon electrolysis.

Corrosion

19763 (AERE-R-3649) THE CORROSION OF ALUMINIUM ALLOYS IN HIGH TEMPERATURE FLOWING WATER. N. J. M. Wilkins, J. T. Dalton, and J. N. Wanklyn (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1961. 21p.

Factors affecting the corrosion rate of aluminium alloys in water flowing at up to 7 ft./sec. at 300°C were studied. The alloys used have good corrosion resistance, <0.002 in. per year penetration, in static water at 325°C. The investigation covered the relative corrosion of the alloys, the effect of replacing specimens during an experiment, contact with stainless steel, pre-filming in static water at 325°C, position of samples in relation to large areas of aluminium in the water circuit, ion exchange rate, and small temperature changes in the water circuit. The effects of most were small, and some of them could be explained in terms of solubility of aluminium in the water. Without surface treatment, corrosion rates were 3 to 4 times higher than in static water at 325°C, but pre-filmed samples retained a rate comparable with that in static water for at least 7 weeks. (auth)

19764 (BM-RI-5784) STRESS-CORROSION CRACKING SUSCEPTIBILITY OF ZIRCONIUM IN FERRIC CHLORIDE SOLUTION. J. T. Dunham and H. Kato (Bureau of Mines. Metallurgical [Div.], Albany, Ore.). May 1960. 33p.

The investigation was initiated for an evaluation test, but was limited to environments consisting of ferric chloride solutions which were known to attack zirconium and were shown to promote stress-corrosion cracking in preliminary tests. Tests for cracking susceptibility were conducted to show the effect of stress, solution concentration, air aeration of solution, and the method of mechanical processing. Tensile stress was applied to the specimens by a constant-load method which proved more reliable than a constant-strain method. Zirconium was found susceptible to stress-corrosion cracking in $FeCl_3$ solutions when the applied tensile stress was above 19,000 psi. Cracking was observed to be intercrystalline with crack propagation normal to the direction of stress. The magnitude of the stress influenced the time for cracking; increasing the stress would decrease the time to fracture. The magnitude of the stress influences the rate of crack nucleation as well as crack propagation; increasing the stress would increase the rate of crack nucleation or film penetration. As the applied stress approaches the yield strength, crack propagation takes place so rapidly that one of the first cracks nucleated propagates to failure before many cracks can be formed. The strength of the solution concentration was observed to influence cracking susceptibility; increasing the solution concentration would decrease the time to fracture. The strength of the solution appeared to affect crack nucleation rather than crack propagation, indicating that the stronger solutions penetrate the oxide film in less time than the weaker solutions. Aeration of the solution was found to significantly decrease the time required for fracture, apparently by increasing the rate of crack propagation. Whether or not susceptibility

as influenced by the material processing, hot-rolling or old-rolling and annealing, could not be determined. The vestigation shows the results only for a particular environment—ferric chloride, where zirconium has poor corsion resistance—and does not support any general statements about the cracking susceptibility of zirconium. owever, it is possible to conclude that if zirconium is to used where high stresses are involved, internally or exrnally applied, and there is some question on the effects the environment encountered, a test for stress-corrosion racking susceptibility is warranted. (auth)

765 (BMI-1230) HIGH-TEMPERATURE OXIDATION ESISTANCE OF THIN IRON–CHROMIUM–ALUMINUM LLOY SHEET. Edward J. Jablonowski, Frederic R. ober, and Ronald F. Dickerson (Battelle Memorial Inst., olumbus, Ohio). Oct. 22, 1957. Decl. May 5, 1961. ontract W-7405-eng-92. 11p.

The oxidation resistance of thin sheets of Fe–28 wt.% r–2.67 to 10.0 wt.% Al alloys, nominally 0.004, 0.006, 008, 0.012, and 0.016 in. thick, was determined by expore in static air for 100 hr at 2100 and 2300°F. A minium of 3.67 and 9.37 wt.% Al was necessary to prevent xcessive oxidation of 0.004-in. thick sheet material at 100 and 2300°F, respectively. Specimens of lower Al ontent and greater thickness withstood oxidation attack. xidation of Fe–Cr–Al alloys appears to be related to the ffusion of Al to surfaces of the sheet to form an adherent rotective layer of Al_2O_3. (auth)

766 (CRMet-857) SOME PRELIMINARY MEASREMENTS WITH AN APPARATUS FOR STUDYING THE RETTING CORROSION OF ZIRCALOY-2. F. H. Krenz, . A. Crawford, and P. G. Anderson (Atomic Energy of anada Ltd., Chalk River, Ont.). Jan. 1960. 23p. (AECL-217)

A special apparatus was designed and constructed for tudying the fretting corrosion of Zircaloy-2 specimens in eplenished water at about 280°C under bearing loads of 00 to 4000 lb/in.^{2} Prefilming (in water at 360°C) reduced enetration in the early stages of fretting, but probably has o permanent effect. More hydrogen was picked up during retting corrosion of a surface than is picked up by that urface corroding normally; however, the amount picked p was small relative to the hydrogen equivalent to the etal consumed by fretting. (auth)

767 (HW-68411) AN EXPLANATION FOR THE CCURRENCE OF DICHROMATE ION IN PRESSURIZED ATER TEST LOOPS. A. P. Larrick (General Electric o. Hanford Atomic Products Operation, Richland, Wash.). lay 9, 1961. Contract AT-(45-1)-1350. 8p.

In order to test the hypothesis that the occurrence of $r_2O_7^{2-}$ in water corrosion test loops is due to oxidation of r_2O_3 in the stainless steel corrosion product, two tests ere run with pH 10 and 7 water at 300°C. The results indicate that the hypothesis is correct. (D.L.C.)

768 (IDO-14506) CORROSION OF ALLOYS IN ARIOUS ICPP DECONTAMINATION SOLUTIONS. T. L. offman and G. S. Adams (Phillips Petroleum Co. Atomic nergy Div., Idaho Falls, Idaho). Apr. 14, 1961. Contract T(10-1)-205. 6p.

Corrosion studies were conducted on stainless steel types 47 and Carpenter-20, Monel, titanium 55A, and tantalum in econtamination solutions. These solutions are: 10% nitric cid, 10% citric acid, 10% sodium hydroxide–2.5% tartaric cid, 10% oxalic acid, 0.003M periodic acid in 0.05M nitric cid, 3% sodium fluoride–20% nitric acid, Turco 4501 and urco 4502, and 0.25M phosphoric acid. Boron stainless steel type 304L was studied in 10% sodium hydroxide–2.5% tartaric acid, 10 and 60% nitric acids, Turco 4501 and Turco 4502. The two austenitic stainless steels were found to be acceptable construction materials for handling each of the decontamination solutions except 3% sodium fluoride–20% nitric acid. Special limitations are defined for Monel, titanium 55A, and tantalum when exposed to decontamination reagents. (auth)

19769 (KAPL-M-CC-2) STRESS CORROSION OF INCONEL IN 550°F AERATED SEA WATER (17,000 PPM CHLORIDE). C. F. Cheng and H. L. Tymchyn (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 1961. Contract W-31-109-Eng-52. 21p.

The stress corrosion resistance to 550°F aerated sea water containing 17,000 ppm chloride was determined for Inconel, Hastelloy-C and -X, A. O. Smith weld overlay, and type 347 stainless steel as control. The tests were made under two conditions: (1) static autoclave with continuous immersion for 77 days and (2) tilting autoclave with alternate immersion for 39 days. Annealed Inconel and Hastelloys C and X were found not to be susceptible to U-bend stress corrosion cracking in (1), whereas type 347 stainless steel suffered transgranular fracture within a few days. In (2), Inconel resisted failure but showed some shallow fine intergranular pits, and the Hastelloys and weld overlay fractured in 1 to 12 days. The results are correlated with the nickel content of the alloys. (D.L.C.)

19770 (KR-8) PITTING OF ALUMINIUM WITH SPECIAL REFERENCE TO PITTING OF HBWR 1st CHARGE FUEL ELEMENTS. Ketil Videm (Norway. Institutt for Atomenergi, Kjeller). Mar. 1961. 39p.

The canning of the HBWR first charge fuel elements which are made of Al with 0.6% Fe and 0.07% Si, pitted severely during the 5 months of introductory physics experiments, a period during which the D_2O purification system was not operated. Corrosion experiments were carried out to find the causes for pitting corrosion. Tests at room temperature of some aluminum alloys showed that no pitting will occur even when the metal is in contact with stainless steel as long as the water is sufficiently pure. Without purification of the water, corrosion products would increase the conductivity considerably and dangerous coupling effects between aluminum and stainless steel might result. Addition of chloride to the corrosive medium was found to increase the pitting corrosion. $NaSiO_3$ did not act as an inhibitor for pitting in the environments of the present experiments. Iron contents up to 0.6% in the alloy were found to have minor effect on the susceptibility to pitting, but addition of 1% Ni aggravated the corrosion. Extensive exposure of various aluminum alloys in very pure water above 100°C produced pitting only in extreme cases. It was concluded that the pitting of the HBWR fuel elements was caused by coupling effects between aluminum and stainless steel and water with a locally high impurity level. (auth)

19771 (NAA-SR-3818) OXIDATION OF ZIRCONIUM, A REVIEW. H. Shimizu (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 5, 1959. 22p.

A comprehensive review is presented on the current status of knowledge on Zr oxidation. The thermodynamics and structure of Zr are reviewed briefly. Kinetic data on Zr oxidation indicate that, after the formation of the initial oxide layer, the rate-determining step is the diffusion of O^{2-} ions through the oxide film via oxide vacancies. The effects of impurities, alloying elements, and O_2 pressure are discussed. Oxidation in liquid sodium is considered. A detailed table of activation energies for Zr oxidation and

for O_2 diffusion in Zr is presented along with 47 references. (D.L.C.)

19772 (NAA-SR-6162) NITRIDING OF TYPE 304 STAINLESS STEEL IN A SODIUM–NITROGEN SYSTEM. J. J. Gill and J. C. Bokros (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 30, 1961. Contract AT-11-1-GEN-8. 14p.

Type 304 stainless steel is nitrided in a 1000°F sodium system covered with nitrogen gas. Observations were made using a flowing-sodium loop. The degree of nitriding is heaviest at the interface between the sodium and nitrogen. The nitriding process strengthens the type 304 stainless steel at elevated temperatures and produces a marked decrease in its ductility. The stress-rupture life is greatly decreased at 1000°F because of nitriding. At a deflection of 0.076 in. producing a stress of 36,000 psi, the flexural fatigue life is significantly increased by nitriding. (auth)

19773 (NASA-TN-D-844) STABILITY OF REFRACTORY COMPOUNDS IN HYDROGEN BETWEEN 4500° AND 5000°F, AND THEIR COMPATIBILITY WITH TUNGSTEN. Charles E. May and Paul D. Hoekstra (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1961. 12p.

Each refractory compound prepared was placed in a tungsten cup which was inductively heated in a hydrogen atmosphere to temperatures between 4500 and 5000°F. Changes in pressure, weight, and crystal structure were taken as indications of reaction. HfC, TaC, TiC, ZrC, HfN, TiN, ZrN, and ZrO_2 showed weight loss due to volatilization, decomposition, or reaction with hydrogen; reaction of TaN was indicated from diffraction data. Any reaction occurring for TaB_2, WB, and NbC was less than the minimum detectable amount. Most of the compounds (except the nitrides) were found to be incompatible with the tungsten container. This prevented the determination of the degree of stability of some of the materials in hydrogen. These results were compared with the earlier work at Lewis Research Center on the stability of these materials in hydrogen between 4000 and 4500°F. (auth)

19774 (ORNL-3063) THE CORROSION OF ALUMINUM ALLOYS IN HIGH-VELOCITY WATER AT 170 TO 290°C. J. L. English, L. Rice, and J. C. Griess (Oak Ridge National Lab., Tenn.). June 15, 1961. Contract W-7405-eng-26. 30p.

Short-term corrosion tests with types 1100, 5154, 6061, and X8001 aluminum alloys were conducted in water at flow rates ranging between 20 and 107 fps and at temperatures between 170 and 290°C. Corrosion of the alloys was less dependent on flow rate in the range of 20 to 67 fps than at higher velocities. At temperatures as high as 230°C no evidence of localized attack, except for random shallow pitting, was exhibited by these alloys, and all had comparable corrosion rates. At 260 and 290°C all alloys except X8001 showed extensive subsurface attack. At 260°C and at velocities up to 67 fps, the corrosion rate of X8001 aluminum was high during the early part of a run and then decreased to rates of between 5 and 15 mpy; at the highest velocity, the corrosion rate was constant at 200 mpy. Tests with X8001 aluminum at 260°C showed that mechanically polished specimens corroded at about the same rate as those with a machine finish. A significant improvement in corrosion resistance at 20 to 67 fps was accomplished, however, by exposing the specimens to water at 250 or 300°C in an autoclave for 24 hr prior to exposure in the loop. At higher flow rates the pretreatment was ineffective. Several experimental alloys containing various amounts of iron, nickel, and silicon were tested at 42 fps and 260°C for 10 days. Although the alloys contained different ratios of iron to nickel and some of the alloys had a very low silicon content, all corroded at the same rate and showed no improvement over X8001. (auth)

19775 (TID-7597(p.612-32)) OXIDATION OF METALS AND THE EFFECT OF RADIATION. J. V. Cathcart (Oak Ridge National Lab., Tenn.).

Oxidation of Nb at about 400°C and 1 atm O_2 pressure produced a surface oxide which was highly subject to crack formation as a result of stresses generated in the oxide film. Exposure to reactor radiation at neutron flux levels of about 6×10^{11} nv failed to alter the oxidation characteristics of Nb. At pressures of 6×10^{-6} to 5×10^{-4} mm Hg and 850°C, the oxidation mechanism proved to be very different. The formation of Nb-O solid solutions became of prime importance and particles of oxide formed internally at pressures as low as 5×10^{-5} mm Hg. (auth)

19776 (TID-7597(p.674-97)) STUDIES ON THE COMPATIBILITY OF HIGH-TEMPERATURE CARBON DIOXIDE WITH STAINLESS STEELS AND OTHER MATERIALS. W. A. Maxwell (General Nuclear Engineering Corp., Dunedin, Fla.).

Materials are being tested for compatibility with CO_2 for use in the Florida Power Reactor. Stainless steels, Fe–Al–Cr alloys, Ni alloys, Croloys, and carbon steels are among the materials studied. The effects of temperature, pressure, solution annealing, gas velocity, and presence of water vapor on corrosion rates were determined. (M.C.G.)

19777 (TID-7597(p.733-47)) THE OXIDATION OF FOUR AUSTENITIC STAINLESS STEELS AND THE NICKEL ALLOY INCONEL IN CARBON DIOXIDE. S. R. Billington, C. G. Stevens, and M. W. Davies (General Electric Co., Ltd., Erith, Kent, England).

Results are given from an investigation of the oxidation resistance of 4 stainless steels (25% Cr/20% Ni, 18% Cr/10% Ni/Ti, 18% Cr/10% Ni/Nb, and 18% Cr/12% Ni/3% Mo) and the nickel alloy Inconel in CO_2 under 100 psig in the temperature range from 600 to 750°C. The weight gain-time curves are shown for each alloy. Under all test conditions the 18/12/3 Mo steel had appreciably higher weight gains than the Inconel, 25/20, and 18/10/Ti alloys. The difference between the weight gains in dry CO_2 and those in CO_2 containing 200 ppm of water vapor was negligible. Micrographs of samples of each material are shown. Results indicated that the most oxidation-resistant materials were 25/20 steel, Inconel, and the 18/10/Ti steel in that order. (M.C.G.)

19778 (TID-7597(p.792-5)) UNITED KINGDOM STEELS COMPATIBILITY PROGRAMME WORK AT CULCHETH. J. A. Waddams (United Kingdom Atomic Energy Authority. Development and Engineering Group, Culcheth, Lancs, England).

The properties of cladding and structural materials for use in gas-cooled reactors were investigated. The intergranular oxidation behavior of stainless steels was studied. Work to determine the limiting temperatures and other service conditions under which carbon and low-alloy ferritic steels can be used was begun. (M.C.G.)

19779 (TID-7597(p.796-805)) OXIDATION OF BERYLLIUM. J. E. Antill and J. K. Higgins (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Work was carried out to extend the data for the behavior of beryllium in CO_2 and O_2 to longer times of exposure and to determine the influence of variables in the fabrication of beryllium sheet. Protective films were formed in dry CO_2 at all temperatures between 500 and 1000°C for times up to

5000 hr. There was little difference between samples. With the addition of 3 to 4 vol.% water vapor to the gas at 700°C, the product was no longer protective and the rate of attack depended markedly on the method used to fabricate the samples. The flake which was leached and then rolled or extruded proved much more resistant than flake which was arc-melted or vacuum cast. The oxide films were non-protective in oxygen after 500 hr. (M.C.G.)

19780 (TID-7597(p.859-70)) GAS CORROSION OF NICKEL-BASE ALLOYS IN 1750°F AIR AND NITROGEN ATMOSPHERES. G. W. Titus (Aerojet-General Nucleonics San Ramon, Calif.).

The effect of ML-1 coolant (N_2 + 0.5 vol.% O_2) on various nickel-based alloys was investigated. The alloys selected were: Inconel, Inconel X, Inconel 702, Hastelloy X, Hastelloy R-235, and Inor 8. Data obtained from these alloys after 2500 and 5000 hr exposures to 1750° N_2 + 0.5 vol.% O_2 at 200 psi are presented. Air corrosion data for the same temperature are also given. After 5000 hr exposure in the ML-1 reference gas, only 0.0035 in. penetration was measured on Hastelloy X, the material chosen for cladding the ML-1 fuel elements. (M.C.G.)

19781 (WAPD-TM-219) EFFECT OF SURFACE TREATMENT ON THE CORROSION RESISTANCE OF ZIRCALOY-2. D. B. Scott (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1961. Contract AT-11-1-GEN-14. 20p.

An experiment was performed to determine the effects of nonpickling versus pickling to depths of one and two mils on the corrosion resistance of Zircaloy-2 machined by various methods. No significant difference in corrosion rate between pickled and unpickled Zircaloy-2 was found, provided that properly sharpened and hardened tools were used. (auth)

19782 (CEA-tr-X-171) ATTAQUE DU ZIRCONIUM PAR LE CO_2 AUX HAUTES TEMPERATURES. (Corrosion of Zirconium by CO_2 at High Temperatures). G. Östberg (Oestberg) (Aktiebolaget Atomenergi, Stockholm). Translated into French from Reports RMM-59-3 and RMM-22. Dec. 13, 1960. 13p.

A bibliographic study is made of the corrosion of Zr and its alloys by CO_2 at high temperatures. Zr can be considered as relatively resistant to CO_2 attack. In the reaction Zr dissolves O_2 and C in such quantities that they exercise a detrimental effect on its solidity. After some time ZrO_2, and to some extent ZrC, is produced. The mechanism of this reaction is imperfectly known. Pure Zr and Zircaloy-2 do not offer sufficient resistance to CO_2 at the temperatures used in gas-cooled reactors. Alloys with Cu and Mo offer higher resistance to corrosion. Russian studies have given data on the effect of Ni, Nb, Sn, and Fe on resistance to CO_2. (J.S.R.)

19783 OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS. G. A. Krier. Battelle Tech. Rev., 10: No. 6, 11-15(June 1961).

Refractory coatings, the only current means of preventing oxidation of refractory metals and their alloys, and refractory coating problems are discussed. (P.C.H.)

19784 CORROSION OF CARBON AND LOW-ALLOY STEELS IN OUT-OF-PILE BOILING-WATER-REACTOR ENVIRONMENT. D. C. Vreeland, G. G. Gaul, and W. L. Pearl (General Electric Co., San Jose, Calif.). Corrosion, 17: 269t-76t(June 1961).

Results are reported of extensive corrosion testing of carbon and low-alloy steels in a dynamic test loop simulating the various environments found in a nuclear boiling-water-reactor system. Quantitative data and metallographic and visual observations of specimens tested in saturated steam, saturated water, and a steam-water mixture, all at 545°F and 1000 psi are presented. Water and steam conditions are based on 10 to 20 ppm oxygen in the steam with a 1:8 stoichiometric ratio of hydrogen to oxygen, a condition representative of the hydrogen and oxygen formed in a boiling-water reactor from radiolytic water decomposition. The water is maintained at pH 7, high purity with no other additives. A description of the boiling-water dynamic-test facilities and operating procedures is included. Total corrosion and corrosion product released into the system is measured. No appreciable difference was noted among corrosion rates of carbon steels, high-strength low-alloy steels and alloy steels studied, although all showed higher rates than the AISI Type 300 series stainless steels tested. Comparisons were also made with other stainless steels. No selective attack was noted on welded specimens. Corrosion rates obtained on the carbon and low-alloy steels are lower than those obtained by other investigators on similar materials in test loops simulating pressurized water-reactor systems operated at high pH (>10) with only hydrogen gas in the water. The iron-to-system rates in the present tests were appreciably lower than those in similar tests in high pH and neutral pH systems with a hydrogen environment. (auth)

19785 CORROSION OF SUPERALLOYS AT HIGH TEMPERATURES IN THE PRESENCE OF CONTAMINATING SALTS. Arthur Moskowitz and Lawrence Redmerski (Crucible Steel, Pittsburgh). Corrosion, 17: 305t-12t (June 1961).

The corrosion of Inconel X, Inconel 702, Rene 41, M-252, and WF-11 (Haynes 25) by potassium chloride and lithium fluoride at 1600 to 1900°F was studied. Thin coatings of the salts (1.5 mg/cm^2) caused severe corrosion of the alloys in air, which resulted in accelerated failures of thin sheet specimens in creep-rupture testing. Rankings for the alloys based on creep-rupture tests were similar for uncoated and salt-coated materials: WF-11, Rene 41, and M-252 best, Inconel 702 poorer, and Inconel X poorest. The corrosion products consist mainly of oxides and spinels, and contain small amounts of chromates. Only very little corrosion, if any, occurs without oxygen. The presence of the salt prevents the normal formation of a protective oxide film. X-ray diffraction studies showed differences between the normal oxidation products and the oxide corrosion products produced with salt present. The types of corrosion include severe surface attack, intergranular penetration, and internal void formation. All of the alloys were susceptible to each of these types of corrosion. Grain boundary separation effects due to stress (2,500 to 10,000 psi) were also found. (auth)

19786 OXIDATION OF NIOBIUM. Tor Hurlen (Sentralinstitutt for Industriell Forskning, Oslo). J. Inst. Metals, 89: 273-80(Apr. 1961).

The reaction of niobium with oxygen at pressures from 10^{-2} to 760 mm Hg and temperatures from 150 to 1000°C was studied by gravimetric and volumetric rate measurements and by x-ray diffraction, electron diffraction, electron microscopy, and metallographic techniques. The time-dependence indicates the following consecutive oxidation stages: linear(I), parabolic(II), a rate-increasing transition, linear(III), parabolic(IV), and parabolic(V). The effect of oxygen pressure and of temperature on the occurrence and rate of the various types of oxidation is quantitatively discussed. A close correlation was found between the oxidation rate and the oxidation products formed. The

solution of oxygen in the niobium lattice plays an essential role. This reaction, free from interference by simultaneous formation of oxide on the metal surface, was studied. Among the oxidation products, three phases with structures closely related to that of pure niobium were detected, only one of which has previously been described. In the case of specimens oxidized above 800°C, pentoxide whiskers appear on top of the oxide scale. Whiskers up to 30 μ long were observed. (auth)

19787 FURTHER OBSERVATIONS ON THE UNIFORM CORROSION OF ALUMINUM ALLOYS IN HIGH-PRESSURE STEAM. J. N. Wanklyn and N. J. M. Wilkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inst. Metals, 89: 289-91(Apr. 1961).

Previous work (J. Inst. Metals, 1959–60, 88, 134) revealed an apparently strong pressure-dependence of the uniform corrosion of aluminum alloys in high-pressure steam. Results show that widely differing corrosion rates can be obtained at a given temperature and pressure by varying the experimental conditions. Dryness of the steam is an important factor in determining the corrosion rate, and this may outweigh the pressure effect previously found. (auth)

19788 CORROSION PROTECTION IN REACTOR CONSTRUCTION. M. Stendel (Brown, Boveri & Cie., AG.). Kerntechnik, 3: 169-70(Apr. 1961). (In German)

Requirements on reactor construction materials with respect to temperature and corrosion stability lead to special surface treatments and the development and improved high-temperature and corrosion-stable alloys. The important protective and surface treatments are described. (tr-auth)

19789 ELECTRODE POTENTIAL AND CORROSION BEHAVIOR OF SOME BORIDES OF MOLYBDENUM AND ZIRCONIUM. W. Beck (American Electro Metal Corp., Yonkers, N. Y.). Planseeber. Pulvermet., 9: 96-108(Apr. 1961). (In English)

The corrosion of the compound MoB in a 0.1N KCl solution was slight but increased with time and was determined by the weight loss and formation of boric acid in solution. The corrosion process was related to the electrolytic decomposition of the compound MoB, probably brought about by local cell currents between anodic and cathodic areas consisting of MoB and residual boron. The boron in the compound is anodically oxidized as indicated by the formation of boric acid. The molybdenum, originally bonded to the boron, remains on the surface of the specimen and is converted to a low oxide. The thickness of the oxidic molybdenum layer increases with time, a process which is affiliated with a progressive decrease of the corrosion rate, which is higher on the low temperature alpha modification of MoB than on the high temperature beta modification. As compared with the corrosion of the molybdenum boride, that of the borides of zirconium is of a very low order of magnitude. It is speculated that the potentials of ZrB_2 in 0.1N KCl solution are predominately determined by the zirconium, those of ZrB_{12} by the boron in the compound. In the light of the results obtained in this study, it appears entirely justified to consider the interstitial compounds of molybdenum or zirconium with boron as intermetallic compounds. (auth)

19790 DETERMINATION OF OXIDATION PROCESS WITH NICKEL–CHROMIUM HEAT-CONDUCTING ALLOYS. Volker Schumacher (Vereinigte Deutsche Metallwerke AG, Zwigniederlassung Basse & Selve, Altena/Westfalen, Ger.). Z. Metallk., 52: 280-4(Apr. 1961). (In German)

Alloys with 80 wt.% Ni and 20 wt.% Cr were used for oxidation tests. It is found that oxidation rate and adherence of the oxide layer can be considerably influenced by additions of cerium, calcium or the oxides of these elements. The durability of a heating conductor wire depends mainly on the adherence of an oxide layer. The effect of the above mentioned alloying elements is discussed. (auth)

19791 THE RATE OF Ti AND Ti ALLOY OXIDATION IN AIR AT HIGH TEMPERATURE. I. S. Anitov and S. A. Gorbunov (All-Union Scientific-Research Inst. of Petroleum-Chemical Processes [USSR]). Zhur. Priklad. Khim., 34: 725-34(Apr. 1961). (In Russian)

The oxidation of technically pure Ti and of Ti alloyed with 5% Al, Cr, Cu, Fe, Mo, Si, Sn, and V at 700 to 1000° was studied. It is shown that at 700 to 1000° Al and Cr reduce oxidation, V, Fe, and Cr increase oxidation, while Cu reduces oxidation at the higher temperatures and increases it at the lower temperatures. In contrast to Cu, Mo reduces oxidation at lower temperatures and increases it at higher temperatures; tin has no effect on titanium oxidation. A "catastrophic" oxidation of Ti alloyed with 10% V was observed at 800° and of Ti alloyed with 5% Mo and 5% V at 1000°. (R.V.J.)

Fabrication

19792 (AERE-M-814) THE PREPARATION OF U/Zn ALLOYS ON THE 10 KGM SCALE. B. A. Partridge and R. F. Clayton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 16p.

A description is given of experimental techniques used in the 10-kg-scale preparation of U-Zn alloys with 7.5 to 11.5 wt.% uranium. (auth)

19793 (ARF-2164-12) INVESTIGATION OF HEAT TREATMENT AND WELDING CHARACTERISTICS OF B 120 VCA TITANIUM ALLOY SHEET. Final Report, November 28, 1958 to July 28, 1960. John F. Rudy, Frank A. Crossley, and Harry Schwartzbart (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract NOas 59-6054c. 124p.

A study of the heat treatment and welding of B 120 VCA was undertaken. The effects of various degrees of cold work and post-working re-solution treatment on aging response were determined. Aging experiments included both isothermal and duplex treatments. Isothermal treatments were carried out between 700 and 1000°F for 2 to 400 hours. The duplex treatments consisted of an aging treatment similar to the isothermal treatments followed by a "flash anneal" at 1000 to 1100°F for 5 to 160 minutes. Both cold rolling, as a pre-age treatment, and duplex aging showed important advantages in tensile properties over the commercially popular solution-treat-and-age sequence. Welding poses some difficulty in that, although the as-welded ductility is ample, the ductility of the weld metal is considerably lower than the sheet material for corresponding aging times and strength levels. Duplex aging cycles gave more promising weld metal properties than did isothermal aging. Magnetic stirring, a weld deposition technique intended to refine the weld metal grains and to increase weld metal homogeneity, showed improved tensile properties in duplex-aged weldments. Other weldment treatment modifications—including roll planishing, stress relieving, re-solution treatment, and partial pre-aging of the base metal—did not offer marked advantage in the final aged condition, although further experimentation is called in some areas. The aging behavior of the alloy after the

various pre-age thermal and mechanical treatments, and as a function of the aging cycle per se, is discussed in terms of tensile properties, hardness, microstructure, and published TTT diagrams for the subject alloy, in an effort to arrive at the mechanisms involved. (auth)

19794 (KAPL-M-JDC-4) ARC WELDING OF INCONEL W (AGE-HARDENED) TO INCONEL. J. D. Carey (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 15, 1961. Contract W-31-109-Eng-52. 11p.

Welding tests were made on age-hardened Inconel W plates to Inconel. The results indicate that age-hardened 1-in. thick Inconel W-to-Inconel welds can be made in the fully restrained condition which meet NAVSHIPS 250-1500-1 guided bend, tensile, and metallographic requirements. (D.L.C.)

19795 (KAPL-M-SAT-6) INERT-GAS TUNGSTEN-ARC WELDING OF URANIUM-ZIRCALOY-2 ALLOY FUEL PLATES. S. A. Toftegaard and F. B. Tuttle (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1961. Contract W-31-109-Eng-52. 13p.

Procedures are described which were developed for welding U–Zircaloy-2 alloy extensions to alloy fuel plates, and for welding Zircaloy-2 extensions to Zircaloy-2 filler plates. (D.L.C.)

19796 (MAB-139-M(M3)) A SURVEY BY TASK FORCE ON ALTERNATIVE METHODS FOR MACHINING. Progress Report No. 3. (National Research Council. Materials Advisory Board). Mar. 10, 1961. 67p.

Alternative methods for removing stock are reviewed with respect to the current status of performance and capabilities. Evaluations are made, based on the survey, on projected performance, and capabilities. Specific conclusions and recommendations are presented to assist in formulating a more effective research and development program in manufacturing processes for aircraft materials. (B.O.G.)

19797 (NAA-SR-Memo-5856) PREPARATION AND TESTING OF HIGH PURITY NOBLE METALS AND ALLOYS. D. M. Sellman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 8, 1960. 17p.

Investigations were conducted to study the effects of fabrication procedures on the electronic and magnetic properties of high-purity copper, gold, silver, and copper alloys with aluminum, manganese, and titanium, at 4.2 and 300°K. Measurements made during testing included electric resistivity and magnetoresistivity. The apparatus and techniques described are considered reliable for the preparation of specimens of pure noble metals and alloys without significant contamination. The measurements serve as a good check on the purity of starting materials, the purity of finished specimens, and of the degree of homogeneity of the prepared alloys. (B.O.G.)

19798 (TID-7602(Pt.I)(p.1-11)) FABRICATION DEVELOPMENT OF BERYLLIUM OXIDE–URANIUM DIOXIDE CERAMIC FUEL AT AEROJET-GENERAL NUCLEONICS. J. F. Ward and C. W. Funk (Aerojet-General Nucleonics, San Ramon, Calif.).

The preparation of 70.5 wt.% UO_2–29.5 wt.% BeO pellets for the outer tubes of the second core fuel element for the Gas-Cooled Reactor Experiment is discussed in detail. Sintering problems are discussed. NOPCO-CD-108 organic binder was used both as lubricant and as binder. Approximately 97,000 pellets have been fabricated to tolerance dimensions of 0.176 ± 0.002 in. diam. and within 2% of required density. (D.L.C.)

19799 (TID-7603(p.1-3)) URANIUM–PLUTONIUM CARBIDE FABRICATION AT ARGONNE NATIONAL LABORATORY. R. C. Lied and G. D. White (Argonne National Lab., Ill.).

Fabrication techniques for the production of 80 wt.% UC–20 wt.% PuC reactor fuel are described. The carbides were prepared by reacting a pelletized mixture of the oxide and carbon. The UC and PuC pellets were then ground together in the correct ratio, cold compacted, and fired at 1650°C. The pieces were loaded in stainless steel tubing with a NaK annulus between the pellets and tube wall. Physical characteristics of the PuC and the UC–PuC system were determined. (M.C.G.)

19800 (TID-12444) FIRST QUARTERLY REPORT ON THE PRODUCTION OF SWAGED OXIDE FUEL ELEMENTS. [Period Covered] May 1–July 30, 1960. Friedrich Hofmann and Bernhard Liebmann (Nuklear-Chemie und–Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). AEC 149/EURATOM 132. 9p.

During swaging tests with ground and melted UO_2, the powder was compressed to 95% theoretical density. Similar tests were conducted using Al_2O_3 powders to resolve certain questions regarding the compressibility of the ceramic powders, rapidly and without the use of extensive dust protection measures. Characteristics determined from the tests are tabulated. (B.O.G.)

19801 (TID-12445) SECOND QUARTERLY REPORT ON THE FORMATION OF OXIDIC FUEL ELEMENTS BY MEANS OF THE SWAGING METHOD. Period Covered: August 1–October 31, 1960. Friedrich Hofmann and Bernhard Liebmann (Nuklear-Chemie und–Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). AEC 149/EURATOM 132. 8p.

A study was made of the effects of the bore size and stroke of the stamper on the stamp-density of UO_2. Sintering at high temperatures and chemical treatment was found to cause the bulk- and stamp-density to be increased. (B.O.G.)

19802 (TID-12562) THE POWDER METALLURGY OF PLUTONIUM FUEL MATERIALS. A. E. Ogard, W. C. Pritchard, R. M. Douglass, and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). [1960]. 39p.

Hypostoichiometric plutonium monocarbide, containing about 20% plutonium sesquicarbide, and single-phase stoichiometric plutonium sesquicarbide were prepared by powder metallurgical techniques. The monocarbide pellets from the first sintering at 1250 to 1450°C were of low density (10.5 g/cm^3). Further sintering of ground and repressed pellets resulted in pellet densities up to 13.1 g/cm^3 (96% of theoretical) for the monocarbide and 12.6 g/cm^3 (99% of theoretical) for the sesquicarbides. Arc melting of the sintered pellets produced buttons up to 99% of theoretical density and containing less than 5% impurity carbide phase. Hypostoichiometric uranium monocarbide-plutonium monocarbide solid solutions with no impurities detectable by x ray diffraction or metallography were prepared by these procedures. Pellet densities up to 12.8 g/cm^3 (94.5% of theoretical) were obtained. Sintered cermets composed of plutonium dioxide dispersed in a matrix of molybdenum were prepared by powder metallurgical techniques with resulting densities up to 95.1% of theoretical density. The sinterability of mixtures of plutonium dioxide and molybdenum was determined over the entire composition range, pressing pressures of 40, 60, 80, and 100 tons per square inch, temperatures of 1200, 1400, and 1600°C, and sintering times of 3, 6, and 12 hours. Variation in density with pressing pressures exhibits a maxima near 80 tons per square

inch. Of the three sintering temperatures studied, 1600°C yields the highest densities with the major portion of the sintering occurring in the first 3 hours. Additional heating for 9 hours increases the density up to an additional 8%, depending on the composition and pressing pressure. (auth)

19803 (TID-12799) THE FABRICATION OF WELDED INCONEL-"X" NUCLEAR POWER PLANT COMPONENTS. G. L. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 17, 1961. Contracts AT(11-1)-171 and AF33(600)-38062. 55p. (XDC-61-5-10)

A description is given of the welding, inspection, and heat-treating procedures used when fabricating ultra-high quality components using Inconel-X in thicknesses of 0.020 to 3.500 in. Included are examples of fabrication, ranging from a 0.020-in. wall, 3.690-in. diameter tube to a 69-in. diameter pressure vessel, 96-in. long. (auth)

19804 (Y-1340) THE COLD PRESSING OF SINTERABLE UO_2. R. P. Levey, Jr. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Dec. 15, 1960. Contract W-7405-eng-26. 56p.

The pressing of sinterable UO_2 powders into cylindrical shapes over a range of length-to-diameter ratios and pressures was studied. The magnitude of the die wall-powder friction was evaluated both by direct measurement and by the actual density reduction in pellets under various pressing conditions. At a forming pressure of 8238 psi, a variation in L/D of from 0.1 to 2.0 accounts for an overall density change >20%. Several density pressure correlations, either purely empirical or based upon a simple model, are suggested and the limitations of each are discussed. The compressibility of UO_2 is compared with that of several other sinterable materials. UO_2 appears to be less compressible than all other materials tested save for tungsten powder. The tensile strength of green UO_2 compacts was measured, and a minimum strength of 30 psi is suggested for acceptable handling characteristics. The effect of prepressing powder on the pressure-density relationship is evaluated and shown to increase density and reduce friction. The evaluation of a new die design for use with sinterable UO_2 is described. While the pressure ceiling at L/D = 1 is ~10,000 psi with conventional dies, the new design permits pressing up to 100,000 psi under the same conditions. (auth)

19805 (TT-940) DENSE ARTICLES MADE OF HIGH STABILITY MAGNESIUM OXIDE. O. M. Margulis, K. G. Romanchenko, and A. V. Stovbur. Translated by G. Belkov (National Research Council of Canada) from Ogneupory, 25: No. 3, 132-7(1960). 10p.

A method was developed for making dense plates with a porosity of 1 to 3% of magnesium oxide with spinel bonding possessing a high thermal stability and good strength at high temperatures. The particular features of this technology consist in the use of highly calcined finely milled MgO, the introduction of highly dispersed α-Al_2O_3, pressing the raw material consisting of "false-grained" mass, slow drying with even circulation of the air and two-stage calcining at 1450 and 1750°C in capsules and covered with a powder. (auth)

19806 (TT-947) THE WELDING OF COPPER ALLOYS. R. Köcher. Translated by D. A. Sinclair (National Research Council of Canada) from Metall, 12: 1007-14 (1958). 28p.

The dependence of the specific resistance of copper alloys on the concentration of the various alloying elements is shown. The heat conductivity was found to decrease almost proportionally with the electrical conductance of copper for increasing alloying contents. For welding copper alloys, therefore, little or no preheating is needed. Welding techniques are given for brasses, Cu–Sr, Cu–Si, Al–Cu, and Cu–Ni alloys. (M.C.G.)

19807 COLLOIDAL AND CHEMICAL PROPERTIES OF AQUEOUS SUSPENSIONS OF STABILIZED ZrO_2 AND THEIR RELATION TO THE TECHNOLOGICAL PROPERTIES OF THESE SUSPENSIONS. G. V. Kukolev and A. G. Karaulov (Ukrainian State Inst. of High Refractory Materials, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 2, 215-18(1961). (In Ukrainian)

The casting properties of aqueous suspensions of ZrO_2 were studied. The best results were obtained with pH values ranging from 1.0 to 2.0. (auth)

19808 CONTINUOUS PRODUCTION OF HIGH STRENGTH LEAD STRIP BY DIRECT POWER ROLLING. S. Storchheim and A. Cross (Storchheim Research and Development Inc., Woodside, N. Y.). Planseeber. Pulvermet., 9: 21-5(Apr. 1961). (In English)

High strength, creep resistant lead strip can be produced by direct rolling commercially pure lead powders. Strip produced by this technique is low in cost; i.e., approximately a few cents per pound above the price of the raw materials. Its excellent mechanical properties should permit its widespread use in many applications where more costly alloys of lead are now being used. (auth)

19809 SINTERING BEHAVIOR OF LOOSE METAL POWDERS. H. H. Hausner (Polytechnic Inst., Brooklyn). Planseeber. Pulvermet., 9: 26-32(Apr. 1961). (In English)

In pressureless compacting, the density of a sintered mass of loose powders depends considerably more on particle size, particle size distribution, and particle activity, than for pressure-compacted powders. Examples are given for spherical and irregular shaped stainless steel powders. The powder composition which results in the greatest apparent density does not necessarily sinter to the highest sintered density. It has been shown that the rate of sintering depends on particle size distribution, as well as on the activity of the particles. (auth)

19810 BIBLIOGRAPHY ON POWDER METALLURGY IN NUCLEAR ENGINEERING, 1956-1960. Henry H. Hausner and Helen C. Friedemann (Metallwerk Plansee, Reutte, Tyrol, Austria). June 1961. 124p. $2.00.

An annotated bibliography is presented, consisting of 643 selected references for the period 1956 to 1960, that covers the application of powder metallurgy methods in nuclear engineering. The references are arranged alphabetically according to author. A subject index is included. (B.O.G.)

19811 METALWORKING. PART I. MACHINING. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 24p. $0.10(OTS). (SB-460).

A bibliography on metal machining is presented. The list includes PB reports, AEC reports, and translations added to the OTS collection during 1950 to April, 1961. (About 250 references.) (J.R.D.)

19812 METALWORKING. PART II. MACHINE AND CUTTING TOOLS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 23p. $0.10(OTS). (SB-461).

A bibliography on machine and cutting tools is presented. The list includes PB reports, AEC reports, and translations added to the OTS collection during 1950 to April, 1961. (About 325 references.) (J.R.D.)

19813 METALWORKING. PART III. CASTING AND FORGING. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 26p. $0.10 (OTS). (SB-462).

A bibliography on metal casting and forging is presented. The list includes PB reports, AEC reports, and translations added to the OTS collection during 1950 to April, 1961. (About 430 references.) (J.R.D.)

19814 METALWORKING. PART IV. ROLLING, DRAWING, AND EXTRUSION. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 16p. $0.10(OTS). (SB-463).

A bibliography on rolling, drawing, and extrusion is presented. Listing includes PB reports, AEC reports, and translations added to the OTS collection during 1950 to April, 1961. (About 235 references.) (J.R.D.)

19815 MANUFACTURE OF FUEL ELEMENTS FOR BREEDER REACTORS. (to DEGUSSA). Belgian Patent 575,379. Priority date, Feb. 4, 1958.

The process consists in sintering uranium or plutonium carbide, on their own, or mixed with ZrC, NbC, TaC, in order to obtain a solid piece having 15 to 30% porosity. This is then impregnated, under vacuum, at 3400°F with thorium metal. The final product can be irradiated in a reactor and reach temperatures up to 2600°F. (EURATOM)

19816 COVERING OF FUEL CANS WITH A THIN SHEATH OF STEEL OR IRON. (to DEGUSSA). Belgian Patent 587,394. Priority date, Feb. 14, 1959.

The steel or iron sheath can be slipped on the fuel element. A suitable bonding metal is then introduced between the sheath and the element, and the whole assembly is capped and submitted to heat treatment under pressure. The sheath can also be made of a coiled overlapping strip of steel or iron. (EURATOM)

19817 MANUFACTURE OF NEUTRON-ABSORBING STRUCTURAL ELEMENTS. (to Gebr. BÖHLER & Co.). Belgian Patent 590,887. Priority date, July 26, 1958.

Control rods and radiation shields are made of pure or low-alloy Fe or steel containing 2 to 15% neutron-absorbing material (Gd and Sm, for instance). The process consists of sintering these metal powders at 1280°C in a tubular stainless steel mould, hotworking, and coating for protection against corrosion. The density of the finished product is 7.4 g/cm^3 and the Brinell hardness test gives a resistance of 36 to 42 kg/mm^2. (EURATOM)

19818 EXTRUSION AND DRAWING OF BERYLLIUM. John Frederick Sackman, Frank Trowell, and David Brian Wright (to United Kingdom Atomic Energy Authority). British Patent 868,064. May 17, 1961.

A method of extruding or drawing beryllium through a die wherein a layer of silver or gold is provided between the die and the beryllium to prevent contact is described. An adherent coating of silver or gold is deposited on the beryllium by electrolytic action. For warm drawing beryllium the die speed is 0.2 to 40 inches per minute and the temperature of the metal is 400 to 500°C. For extruding the die speed is 1 to 5 feet per second at 500 to 700°C. (N.W.R.)

19819 [FIBER STRUCTURE FUELS FOR REACTORS]. Peter Faber (to W. Lahmeyer & Co.). German Patent DAS 1 037 607. Nucleonics, 19: No. 5, 7(May 1961).

Metal, metalloid, or metallic compound fuels are deposited in thin (~100 mμ) films on supporting surfaces. These surfaces are metallic (Al, Mg, Zr, etc.) or glass-like substances in the form of fibers, chips, wire, wool, etc. The advantages of this type of configuration include flexibility, absence of thermal stresses, higher fuel utilization, and higher thermal efficiency. (T.F.H.)

19820 ECCENTRIC ROLLING OF POWDER AND BONDING AGENT INTO SPHERICAL PELLETS. G. Patton, Jr. and S. Zirinsky (to U. S. Atomic Energy Commission). U. S. Patent 2,986,772. June 6, 1961.

A machine is described for pelletizing powder and bonding agent into spherical pellets of high density and uniform size. In this device, the material to be compacted is added to a flat circular pan which is moved in a circular orbit in a horizontal plane about an axis displaced from that of the pan's central axis without rotating the pan about its central axis. This movement causes the material contained therein to roll around the outside wall of the container and build up pellets of uniform shape, size, and density.

19821 BONDING ALUMINUM METALS. Robert A. Noland and David E. Walker (to U. S. Atomic Energy Commission). U. S. Patent 2,987,816. June 13, 1961.

A process is given for bonding aluminum to aluminum. Silicon powder is applied to at least one of the two surfaces of the two elements to be bonded, the two elements are assembled and rubbed against each other at room temperature whereby any oxide film is ruptured by the silicon crystals in the interface; thereafter heat and pressure are applied whereby an aluminum-silicon alloy is formed, squeezed out from the interface together with any oxide film, and the elements are bonded.

19822 METHOD OF FABRICATING TUBULAR UNITS. Lee A. Ohlinger (to U. S. Atomic Energy Commission). U. S. Patent 2,988,812. June 20, 1961.

A process is described for making a fuel element comprising a tubular jacket and fuel slugs held by the jacket in longitudinally spaced relation to one another. The jacket is lengthened as a result of being drawn down to grip the fuel slugs. As an intentional incident to this operation, the fuel slugs become longitudinally spaced from one another.

19823 CONTROL FOR ROLLING MILL. Arthur B. Shuck and William C. Shaw (to U. S. Atomic Energy Commission). U. S. Patent 2,988,938. June 20, 1961.

A plutonium-rolling apparatus is patented that has two sets of feed rolls, shaping rolls between the feed rolls, and grippers beyond the feed rolls, which ready a workpiece for a new pass through the shaping rolls by angularly shifting the workpiece about its axis or transversely moving it on a line parallel to the axes of the shaping rolls. Actuation of each gripper for gripping or releasing the workpiece is produced by the relative positions assumed by the feed rolls adjacent to the gripper as the workpiece enters or leaves the feed rolls.

Properties and Structure

19824 (AFOSR-436) TENSILE BEHAVIOR OF LITHIUM FLUORIDE. Fourth Technical Report. Donald B. Hoover and Jack Washburn (California. Univ., Berkeley. Materials Research Lab.). Mar. 1961. Contract AF49 (638)-601. 22p.

The experiments were undertaken to determine the effect of slip distribution on the shape of the stress-strain curve. When the number of slip-band sources is small, the yield stress as measured in tension at a given strain rate is a function of the number of slip bands that are nucleated. When large numbers of sources are present the yield stress is probably close to the minimum required to move dislocations in the crystal. A slip band on a given

[110] ($1\bar{1}0$) system is a more effective barrier to subsequent growth of intersecting bands on the four systems that cut through it at 60° than it is slip on the one other system that cuts through it at 90°. (B.O.G.)

19825 (ARF-2198-16) IMPROVED ZIRCONIUM ALLOYS. Monthly Report No. 12, April 1–April 30, 1961. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 4, 1961. Contract AT(11-1)-578. 5p.

Specimens which previously showed promising corrosion resistance in 750°F steam after 329 hr exposure were re-entered in test for an additional 480 hr. Additional tin alloys were included. The compositions Zr–0.5 Nb, Zr-IV, and Zr–1 Sb and the alloys Zr–Fe, Zr–Cr, and Zr–Mo appeared the most promising. The corrosion resistance of Zr–Sn alloys was not sufficient to consider the alloy for further development. (M.C.G.)

19826 (BMI-1036(Del.)) THE MECHANICAL PROPERTIES OF BETA-QUENCHED URANIUM AT ELEVATED TEMPERATURES. Frederic R. Shober, Lyle L. Marsh, and George K. Manning (Battelle Memorial Inst., Columbus, Ohio). Sept. 6, 1955. Decl. with deletions Dec. 1, 1959. 31p. Contract W-7405-eng-92.

The creep strength and tensile properties were determined in vacuum for beta-quenched, derby uranium. The stresses to produce a secondary creep rate of 0.0001 per cent per hr at 100, 250, 400, and 500°C were 48,000, 35,500, 4,600, and 1,300 psi, respectively. Ultimate tensile strengths were 114,500, 35,100, 11,100, and 8,500 psi at temperatures of 28, 300, 500, and 700°C, respectively. The creep and tensile strengths decrease quite rapidly with increasing temperature in the temperature range 250 to 400°C. (auth)

19827 (CEA-1678) LES ECHANGES THERMIQUES DANS LA METHODE B.E.T. (Thermal Exchanges in the B.E.T. Method). C. Moreau (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1960. 9p.

Studies of textural properties are useful in powder metallurgy and in heterogeneous kinetics and at a time when use of the B.E.T. method is becoming more widespread it seems desirable to point out a limitation to the exactness of the absolute measurements: it is caused by the uncertainty concerning the exact temperature of the powdered solid. It is assumed that this temperature is the same as that of the liquified gas around the sample. Several cases were studied and the assumption was found to be incorrect; it is thus necessary to introduce into the method another experimental variable: the exact temperature of the absorbant. (auth)

19828 (DMIC-Memo-103) THE EMITTANCE OF COATED MATERIALS SUITABLE FOR ELEVATED-TEMPERATURE USE. W. D. Wood, H. W. Deem, and C. F. Lucks (Battelle Memorial Inst., Columbus, Ohio). May 4, 1961. 138p. (PB-171611)

A compilation was made of original test data on emittance and reflectance of coated materials suitable for use at elevated temperatures. The data were taken from the literature published during the period 1940 to 1959, inclusive, and from some 1960 literature. The data are separated according to type of coating and type of measurement, whether spectral or total. All data were plotted and an information sheet accompanying each graph gives the names of the investigators and the reference from which the data were obtained. Data are presented on boride and carbide coatings on tantalum and tungsten; enamels on Inconel and stainless steel; paint on titanium; oxides on Inconel, stainless steel, Nimonic-75, tungsten, and molybdenum; silicides on molybdenum, niobium, and tungsten; and other miscellaneous coatings. (M.C.G.)

19829 (HW-67793) STUDIES OF SURFACE SORPTION IN GAS–GRAPHITE SYSTEMS; PRELIMINARY REPORT. T. J. Clark and R. C. Giberson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 22p.

Gravimetric studies, at 25 to 733 C, indicate that the initial weight changes of clean graphite, when exposed to flowing CO_2, CO, or O_2, are almost entirely caused by physical adsorption processes. An upper limit of 1.4×10^{17} chemisorption sites/gram was determined for reactor electrographite. Displacement of physically-adsorbed CO by CO_2 can lead to the appearance in the gas phase of the same quantity of CO as would be released by chemisorption of CO_2 in the reaction, $C_f + CO_2 \rightarrow C(O) + CO$. The results must be considered in proposing or evaluating models for the CO_2-graphite reaction. Kinetic equations, which describe the rate of adsorption as a function of the available area, were derived. (auth)

19830 (JPL-TR-32-71) TENSILE PROPERTIES OF PYROLYTIC GRAPHITE TO 5000°F. W. V. Kotlensky and H. E. Martens (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 10, 1961. Contract NASw-6. 18p.

Tensile properties of pyrolytic graphite were measured parallel to the basal planes from room temperature to 5000°F. The gage section of the test specimen was 0.06 by 0.10 in. in cross section and $^3/_4$-in. long. The specimens were heated in a helium atmosphere by an external graphite heater and were tested at a strain rate of approx 2×10^{-4} in./in./sec. Tensile strengths at room temperature varied from 6,000 to 19,000 psi with elongations of less than 1%. At 3000°F the strength and elongation were approximately the same as at room temperature. At 4000°F there was a very slight increase in the strength and elongation. At 4500°F tensile strengths to 35,000 psi and elongations up to 3%, and at 5000°F tensile strengths of 64,000 psi and elongations greater than 70% were measured. At 4500°F and above load-deformation curves were recorded. Microstructure and x-ray diffraction patterns showed that marked structural changes accompany deformation at 5000°F. Large changes in room-temperature dimensions, parallel and perpendicular to the basal planes, were measured after heating, with no load, to temperatures in this same range. (auth)

19831 (LMSD-894817) ORGANIC SEMICONDUCTORS. I. THE PHTHALOCYANINES. Charles John Hoffman (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Mar. 1961. 28p.

The chemistry and semiconducting properties of phthalocyanines and phthalocyanine polymers are reviewed. An introduction is given to the conduction mechanism occurring in organic semiconductors. Applications of the mechanism to phthalocyanines are discussed. (auth)

19832 (NAA-SR-5838) ON THE MECHANISM OF YIELDING AND FLOW IN IRON. H. Conrad (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 30, 1961. Contract AT(11-1)-GEN-8. 40p.

The activation energy, activation volume, and frequency factor were evaluated for yielding (delay time for yielding, upper yield stress, lower yield stress, and Lüders band propagation) and flow (friction stress, flow stress, and dislocation mobility) for various irons and steels from data in the literature. It was found that the values of these flow parameters and their stress dependence were the same,

within experimental error, for both yielding and flow, and for all the materials considered. This suggests that either the same dislocation mechanism is controlling in every case, or that one or more mechanisms possess approximately the same values for these parameters. The dislocation mechanism for which there was closest agreement between theoretical calculations and experimental data was overcoming the Peierls stress. On the basis of the available experimental data and the present analysis, it is suggested that the upper and lower yield stresses in iron and steel may represent the sudden generation of a large number of dislocations by the double cross-slip mechanism of Koehler and Orowan, rather than the breaking away from a Cottrell atmosphere. (auth)

19833 (NAA-SR-Memo-5686) PERMEATION RATES OF HYDROGEN THROUGH METALS AND CERAMIC-COATED METALS AND CERAMICS—UNCLASSIFIED BIBLIOGRAPHY. Marianne J. Chapman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 13, 1960. 6p.

A bibliography is presented consisting of 47 references to books, journals, and reports from 1955 to 1960 on the permeation rates of hydrogen through ceramics, ceramic-coated metals, and metals. Sources searched include: Bulletin of the American Ceramic Society; Journal of the American Ceramic Society; Applied Science and Technology Index; ASM Review of Metal Literature; Ceramic Abstracts; Monthly Catalog of Government Publications; Nuclear Science Abstracts from 1955 to 1960; and U. S. Government Research Reports for 1957 to 1960. (B.O.G.)

19834 (NAA-SR-Memo-5785) EVAPORATION RATE STUDIES. H. H. Hanlin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 14, 1960. 10p.

Langmuir's equation relating the evaporation rate of a material in vacuum to its vapor pressure is used to derive evaporation rate vs temperature tables and graphs over the range 700 to 2100°F for the following materials: Al, Be, Cr, Co, Cu, Ge, Au, Fe, Mg, Mn, Ni, Pt, Ag, Si, Sn, Ti, U, and V. The information should be useful in the SNAP-8 program. (D.L.C.)

19835 (NAA-SR-Memo-5933) BERYLLIUM AND ZIRCONIUM ALLOYS FOR GBSR COOLANT TUBE APPLICATION. R. A. Harlow and R. K. Wagner (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1960. 15p.

A literature survey was made to investigate the properties of the low cross-section materials that are being considered for pressure tube applications in the GBSR. Physical and mechanical properties of beryllium and two zirconium alloys, zircaloy 2 and 321, showed that these materials exhibit useful elevated temperature strength for the intended application, but their corrosion rates may impose limitations on the use of either material. A second disadvantage of beryllium is its extremely low ductility which decreases on irradiation. For preliminary design, allowable stress levels of 10,000 psi at 600°F and 8000 psi at 700°F are suggested for the zirconium alloys, zircaloy 4. (auth)

19836 (NAA-SR-Memo-5934) HIGH TEMPERATURE X-RAY DIFFRACTION INVESTIGATION OF BeO. K. T. Miller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 2, 1960. 4p.

The coefficient of thermal expansion of BeO was measured for the a and c axes in the temperature ranges 0 to 1700°C and 1200 to 1700°C. The crystallographic structure (a_0 and c_0) was also determined at 25°C and 1215 to 2050°C. (D.L.C.)

19837 (NAA-SR-Memo-5952) AN EVALUATION OF THE COMPATIBILITY OF SOME OF THE SNAP 2 CORE MATERIALS. L. B. Lundberg (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 9, 1960. 15p.

Chromium coatings on materials intended for use in the SNAP 2 core cooling system were studied for mutual compatibility under simulated reactor conditions. In an attempt to improve the compatibility of beryllium with other core components the following diffusion couples were tested for 1000 hr in a 1300°F dynamic NaK system: Cr plated Be-Hastelloy N, Cr plated Be-Hastelloy C, Cr plated Hastelloy N-Be, Cr plated Hastelloy C-Be, chromized Hastelloy C-Be, Ti-Be, Ti-Hastelloy N, and Ti-Hastelloy C. With the exception of the chromized Hastelloy C-Be couple, diffusion was observed to take place between all of the couples tested. Chrome plating separated from the beryllium during the test because of an excessively thick copper flash deposited prior to the electro-deposition of chromium. (auth)

19838 (NAA-SR-Memo-6015) LOW FREQUENCY CONDUCTIVITY OF OMRE COOLANT SAMPLES. R. L. Carter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 5, 1961. 12p.

Experiments were carried out to determine if the presence of two varieties of charge carrier could be detected in organic coolant in the absence of radiation field by the anomalous variation of electric conductivity with frequency of electric field. The fluid whose conductivity was measured was enclosed in a vial immersed in a constant high temperature bath. No change with frequency of measurement in the electrical resistance of samples of OMRE coolant was observed over the frequency range from 300 to 10,000 sec^{-1}. Low frequency transient measurements, in which the decay of electrostatic potential in the fluid in time intervals extending from 2 msec. to 10 sec. would show the presence of significant concentrations of low mobility charge carriers, also gave negative results. It was concluded that the predominant electrical conduction mechanism active in out-of-pile coolant involves molecular ions. (M.C.G.)

19839 (NDA-Memo-15E-117(Del.)) SUMMARY OF AVAILABLE DATA ON LITHIUM. A. A. Strasser (Nuclear Development Associates, Inc., White Plains, N. Y.). July 22, 1955. Decl. with deletions Jan. 26, 1960. 45p.

A summary of data on lithium is presented. Information is included on chemistry and chemical analysis, physical properties, corrosive properties, purification, handling, machining, alloys, and suggested investigations. (J.R.D.)

19840 (NP-10063) TEMPERATURE EFFECTS ON MATERIAL CHARACTERISTICS. A. J. Murphy and A. J. Kennedy (College of Aeronautics, Cranfield, Bucks, England). 33p.

Paper presented at Fourth AGARD Combustion and Propulsion Colloquium, Milan, April 1960.

A review is given of the material characteristics of some metals, cermets, and graphite for high-temperature applications. Mechanical properties are presented as functions of melting points, atomic weights, and temperatures. The characteristics are summarized in light of aeronautical and space requirements. (B.O.G.)

19841 (NP-10088) IMAGE OF THE FERMI SURFACE IN SPIN WAVE SPECTRA OF RARE EARTH METALS. Edwin J. Woll, Jr. and Stephen J. Nettel (California. Univ., La Jolla). 1961. Contract NONR-2216(11). 21p.

Calculations of spin wave spectra in rare earth metals were carried out to find whether images of the electronic Fermi surface might be observable. In the space of spin wave vectors $\underline{q}$ there should occur surfaces on which the

frequencies have an infinite gradient with respect to q, the location of such abrupt changes, kinks in the dispersion curves, being determined by the shape of the Fermi surface. The spin wave spectrum is found by assuming that the coupling between ionic spins takes place primarily through exchange scattering of conduction electrons, paralleling the calculation of the coupling of nuclear spins. Spin wave dispersion curves in two directions of high symmetry are computed. The sought-for kinks in the dispersion curves are found to amount to about 2% of the maximum excitation frequency. The development is for ferromagnets, but extension to spiral anti-ferromagnets is taken briefly. (auth)

19842 (NP-10142) RARE EARTH INTERMETALLICS. Second Bi-monthly Report, January 15–March 15, 1961. (Nuclear Corp. of America. Research Chemicals Div., Burbank, Calif.). Contract NOw-61-0257-c. 11p. (RC-173).

Chemical compositions are given for Hf–Re, Hf–B, and Hf–Dy intermetallics prepared by arc melting. Their oxidation resistance at 1000°C was measured at intervals up to 8 hr; Hf–Dy and Hf–Re were found to have higher weight gain per unit area than Hf, whereas Hf–B showed a considerable decrease in oxidation rate. (D.L.C.)

19843 (NP-10144) EVALUATION OF COATINGS FOR MOLYBDENUM. Bi-Monthly Progress Report No. 1, May 18, 1960–July 15, 1960. Charles R. Wilks, Harry Magalotti, and John V. Mumford (Martin Co., Baltimore). Aug. 9, 1960. Contract NOw-60-0321c. 13p. (ER-11462-1).

Technical considerations affecting the performance of manned vehicle structures are given. An experimental program for evaluating coatings of W-2, Al–Cr–Si, LM-5, and Al–Si on Mo–0.5% Ti is described. (D.L.C.)

19844 (NP-10151) CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH PROGRAM. Quarterly Progress Report No. 5, January 1, 1961–March 31, 1961. J. A. Coffman, K. L. Coulson, and G. M. Kibler (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 31, 1961. Contract AF33(616)-6841. 51p.

Carbonization of Plastics. The carburization rate of synthetic phenol samples in an arc image furnace was investigated. X-ray diffraction examination of the carbonized ends indicated some difference in ease of graphitization between polyphenylene and phenolic resin. Phenolic resin samples containing powdered W, Nb, etc., gave evidence of carbide formation. Gases evolved from phenolic and epoxy resins at 200 to 900°C were collected and subjected to mass spectrometric analyses. The effects of semi-carbonized filler material on the thermal conductivity of polyethylene were investigated and found to be rather small. Elemental analyses were carried out on moded phenolic disks heated in a thermogravimetric apparatus to temperatures of 500 to 900°C. Vapor Pressure of Refractory Materials. The vapor pressure of HfC was measured at temperatures from 2533 to 3138°C; lattice constant measurements indicated congruent vaporization. A WC specimen was heated to a total weight loss of ~2.5% of its initial weight; an inner core of WC with W_2C near the surface was found. The free energies of formation of ZrC and TiC were determined to be −38.755 kcal/mole at 2740°C and −35.15 kcal/mole at 2220°C, respectively. Spectral Emissivities of Refractory Materials. The computed normal emissivities of ZrC, TaC, W, Ta, and Mo are given. The role of cross-over points is discussed. Experimental data are reported for Mo, W, and WC specimens. (D.L.C.)

19845 (NP-10173) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1961. 75p.

A list is presented of selected accessions on high-strength alloys, light metals, nonmetallics, refractory metals, and miscellaneous related subjects. Abstracts are included for most items. (About 150 accessions.) (J.R.D.)

19846 (NP-10179) PLASTIC PRESSURE TUBING AND FITTINGS. An Annotated Bibliography. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Apr. 1961. 23p. (SB-61-15)

Selective references to aid in evaluating plastic material for tubing and fittings are given. The purpose of the search was to find availability, usage, and application of plastic pressure tubing and fittings capable of withstanding 200 psi and temperatures of 200°F. The material was to be of a non-woven type, impervious to water, and to have not less than a three year lifetime. (auth)

19847 (NP-10187) RESEARCH ON PROPERTIES OF CLEAN SURFACES. Final Report. S. R. Morrison (Minneapolis-Honeywell Regulator Co. Ordnance Div., Hopkins, Minn.). May 1961. Contract AF49(638)-597. 29p.

Experiments were performed to determine the surface-band structure of clean surfaces produced by cleavage in ultra-high vacuum on germanium, InSb, and silicon. A clean Ge surface is highly p-type with the Fermi level at the surface near the valence band. This is brought about by acceptor-like surface states in the valence band with a density of 2 to 3×10^{12} cm^{-2}. The density of the low-lying surface states decreases when the surface is exposed to oxygen. A clean Si surface is nearly intrinsic, possibly slightly n-type, indicating that the dominant surface states are near the center of the forbidden gap at the surface. Preliminary results on InSb are reported. (auth)

19848 (NP-10196) INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 20, February 1, 1961 to April 30, 1961. N. E. Poulos, S. R. Elkins, and J. D. Walton (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract NOrd-15701. 53p.

X-ray diffraction analysis showed the absence of cristobalite in the ethyl-silicate-40-impregnated samples. This indicated that the samples did not reach 2150°F for the time indicated. The aluminum–chloride–impregnated slip-cast fused silica studies were continued. The effect of multiple impregnation on the strength of the fused silica test bars impregnated with 10, 30, and 50% solutions was determined. A decrease in strength and an increase in cristobalite content were exhibited by all samples with each successive impregnating and refiring cycle. A revised vacuum-pressure technique of impregnating slip-cast fused silica was studied. The transverse strength of the samples was not appreciably affected as the number of impregnation and refiring cycles was increased. The study initiated to seal the surface of the slip-cast fused silica by flame glazing with a plasma flame system was continued. The best combination of traverse speed and standoff distance was $3\frac{1}{8}$ in./min and 0.8 in., respectively. However, the samples cracked on cooling to room temperature. It was found that the fused silica samples could be glazed by annealing in an infrared quartz tube furnace. A study was initiated to develop a technique for flame spraying alumina coating on the surface of slip-cast fused silica using an arc-plasma gun. The possibility of sealing the surface voids by flame spraying a thin coating of spodumene and petalite is being investi-

gated. Thermal shock samples were fabricated and shock tests initiated. (auth)

19849 (NP-10201) ACOUSTICAL STUDY OF QUENCH-AGING IN α Cu–Al ALLOYS. Technical Report No. 4. Theodore J. Koppenaal and Morris E. Fine (Northwestern Univ., Evanston, Ill. Technological Inst.). Apr. 12, 1961. Contract NONR 1228(11). 8p.

Young's modulus at 21°C in quenched α Cu–Al alloys increased with time. This correlated with a decrease in resistivity which was attributed to vacancy enhanced diffusion and short-range ordering. The total change in modulus during aging increased with Al content and quenching speed and was also a function of the quenching temperature. An effective activation energy of 0.69 ev was determined 38 minutes after quenching. This was an effective energy of motion for the point defects involved in the diffusion process at this point in the reaction. (auth)

19850 (NP-10202) YIELD POINTS IN α–Cu–Al SINGLE CRYSTALS. Technical Report No. 3. T. J. Koppenaal and M. E. Fine (Northwestern Univ., Evanston, Ill. Technological Inst.). Apr. 12, 1961. Contract NONR 1228(11). 22p.

A yield point effect attributed to short-range ordering (SRO) occurred in Cu-base Al single crystals. $\Delta\tau$ at 296°K varied with heat treatment, decreasing as the annealing temperature was raised from 433 to 598°K. Davies and Cahn observed a corresponding decrease in SRO. $\Delta\tau$ (523°K anneal, measured at 77°K) was approximately proportional to $[c_{Al}(1-c_{Al})]^2$. The variation of $\Delta\tau$ with strain rate and testing temperature was also consistent with the idea that $\Delta\tau$ is associated with SRO. (auth)

19851 (NP-10203) A STUDY OF THE GROWTH OF VOIDS IN COPPER DURING THE CREEP PROCESS BY MEASUREMENT OF THE ACCOMPANYING CHANGE IN DENSITY. Raymond C. Boettner (Ford Motor Co., Dearborn, Mich.) and W. D. Robertson (Yale Univ., New Haven. Hammond Metallurgical Lab.). [nd.] 40p.

A study was made of the change in density during the first (transient) and second (linear) stages of the creep curve of polycrystalline copper as a function of stress, temperature, plastic strain, impurity and atmosphere effects, and structure, including single crystals. Voids did not grow in single crystals strained 15% at 500°C, or in a polycrystalline aggregate produced by recrystallizing a single crystal. It appeared that voids are heterogeneously nucleated at grain boundaries by an insoluble phase, or phases, which can be removed by directional solidification. The principal controlling mechanism of void growth appeared to be condensation of vacancies at grain boundaries. Vacancies are transported to a boundary and condense as a consequence of the tensile stress component across the boundary, which depends on the orientation and configuration of the boundary plane and on boundary shear across ledges and other irregularities. The ultimate source of vacancies is the free surface and diffusional transport is by way of the boundary plane. (auth)

19852 (NP-10208) A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTHS AND RELATED METALS. Semi-Annual Progress Report No. 3, November 1, 1960–April 30, 1961. Albert S. Yamamoto, Charles E. Lundin, and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). May 1961. Contract AF33(616)-6787. 26p.

A number of minor modifications were incorporated into the Knudsen effusion apparatus, resulting in significant improvements in accuracy of the data obtainable. Vapor-pressure determinations of high-purity liquid silver were completed and agree excellently with published data. A series of praseodymium-neodymium alloys in increments of 10 atomic percent were arc melted, and x-ray fluorescence analytical procedures were developed using these alloys as standards. Because of the low vapor pressure of praseodymium, necessitating higher operating temperatures, difficulties with the platinum/platinum-rhodium thermocouples were experienced. The use of tungsten/rhenium thermocouples is now being considered to remedy this difficulty. The Knudsen effusion apparatus was found to serve as an excellent thermal-analysis unit. Good agreement was obtained between experimentally determined transition and melting temperatures of praseodymium and those in the literature. (auth)

19853 (NP-10255) THE EFFECT OF PLASTIC DEFORMATION ON SELF-DIFFUSION IN NICKEL. Third Technical Report; Series 114, Issue No. 3. A. R. Wazzan, J. Mote, and J. E. Dorn (California. Univ., Berkeley. Materials Research Lab.). Apr. 18, 1961. Contract AF49(638)-58. 33p.

The coefficient of self-diffusion in nickel single crystals in the unstrained state, D_u, is found to be a function of temperature and is represented by the following equation: $D_u = 1.9 \exp[-(66{,}800/RT)](cm^2/sec)$. When D_u undergoes plastic deformation (tensile) from 0.0085 to 0.055 hr^{-1} at 948 ± 1.5°K and 1021 ± 1.5°K, it is found that the coefficient of self-diffusion increased with an increase in strain rate at a constant temperature and decreased with an increase in temperature at constant strain rate. These results are discussed in terms of a model which assumes that vacancies are produced by the motion of jogged screw dislocations and the thermally activated climb of edge dislocations and that vacancies anneal by migrating to fixed sinks, dislocation lines. The analysis indicates that the motion of jogged screws may be an unimportant source for vacancies at these temperatures and strain rates. (auth)

19854 (OOR-1922:4) RATES OF GROWTH DURING SOLID-SOLID TRANSFORMATIONS. Final Report. H. W. Paxton (Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab.). Mar. 1, 1961. Contract DA-36-034-ORD-3987 RD. 15p.

The kinetics and morphology of austenite produced by carburizing single crystals of zone-melted ferrite between A_1 and A_3 were studied. The austenite is frequently irregular and even acicular without any obvious consistent crystallographic relation or habit plane. Calculations of the rate of growth of austenite based on a model involving carbon diffusion as the controlling step give values lower than the observed penetration rates of acicular austenite but consistent with those for the more uniform advance noted occasionally. (auth)

19855 (OOR-2064:2) THE EFFECT OF THE ELASTIC INTERACTION ON THE RATE OF CLUSTER GROWTH. Report No. 61-11. George Sines, W. Grupen, R. Kikuchi (California. Univ., Los Angeles. Dept. of Engineering). Feb. 1961. Contract DA-04-495-ORD-1250. 55p.

When point defects, such as foreign atoms, atoms displaced from their equilibrium sites, or vacant lattice sites, are present in a metal in sufficiently supersaturated concentrations, clusters of these defects are formed. The migration of additional defects toward these clusters may be biased by long-range interactions with the clusters. The results of an examination of the effect of elastic interaction on the rate of cluster growth are presented. This effect was shown to be appreciable for the cases chosen for study. For the disk cluster, the effect is greater for disks of larger diameters. (auth)

19856 (RAD-SR-61-54(Rev.1)) THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN REFRACTORIES. Quarterly Technical Summary Report No. 5. A. A. Hasapis, A. J. Melveger, M. B. Panish, L. Reif, and C. L. Rosen (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). May 3, 1961. Contract AF33(616)-6840. 37p.

Vaporization studies were conducted for B-Ta, Mo-Si, and Si-W systems, HfO_2, rare earth oxides, and ruthenium. Surface tension measurements were made for pure silica at 1830 to 2250°C and silica plus 1% admixtures of Al_2O_3, Cr_2O_3, CoO, MgO, V_2O_5, and ZrO_2 at temperatures above the melting points. (B.O.G.)

19857 (SB-458) COPPER. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Apr. 1961. 25p.

An extensive bibliography is presented on reports on copper metal and alloys, copper compounds, copper wire, brass, and bronze. The bibliography covers reports listed in U. S. Government Research Reports and Technical Translations. (D.L.C.)

19858 (TID-7597(p.374-90)) THE STRUCTURE AND REACTIVITY OF PILE GRAPHITE. R. L. Bond, D. H. T. Spencer, and P. A. H. Tee (British Coal Utilisation Research Assn., Leatherhead, Surrey, England).

An attempt was made to characterize, as completely as possible, a number of graphites possessing different capillary structures and to investigate the influence of these different structures on the rates of oxidation of the graphites under a range of conditions in the absence of irradiation. One graphite studied exhibited a total porosity of about 23%, 1/6 of which was inaccessible to helium or other fluids. The bulk of the porosity was reached through openings whose average was 2 μ. No molecular sieve behavior was found to be associated with the microstructure of the specimens. It was found that the rate of flow of carbon dioxide over and through the samples affected their rates of burn-off. The greater rates of burn-off occurred in those experiments in which the larger quantity of gas was forced through the graphite. (M.C.G.)

19859 (TID-7597(p.748-91)) EFFECT OF ENVIRONMENT ON THE CREEP PROPERTIES OF TYPE 304 STAINLESS STEEL AT ELEVATED TEMPERATURES. H. E. McCoy and D. A. Douglas (Oak Ridge National Lab., Tenn.).

A study was made of the creep properties of type 304 stainless steel in Ar, CO, CO_2, H_2, N_2, O_2, and air at 1300, 1500, and 1700°F. These studies were made to determine what problems might exist in utilizing this material for capsulating UO_2 fuel in a helium-gas-cooled, graphite moderated reactor containing small amounts of these gases as contaminants. Equivalent creep behavior was obtained in argon and helium environments when other testing variables were the same. Air and nitrogen increased the creep resistance of this material at 1500 and 1700°F over that observed in argon. No strengthening was noted in an environment of pure oxygen, suggesting that nitrogen is responsible for the strengthening observed in air. Carburization occurred in an environment of pure CO at 1300 through 1700°F. It occurred in CO_2 in the same temperature range even if the CO level in the gas was less than 500 ppm. Both environments increased the creep resistance. Copper plating was effective at 1300°F in decreasing the carburization rate of this material under stress in a CO environment. (auth)

19860 (TID-7602(Pt.I)) PROCEEDINGS OF THE BERYLLIUM OXIDE MEETING HELD AT OAK RIDGE NATIONAL LABORATORY, DECEMBER 1 AND 2, 1960. (Oak Ridge National Lab., Tenn.). 41p.

Five papers are included which were presented at the Beryllium Oxide Meeting. The topics treated are preparation of beryllium oxide and fabrication and radiation testing of fueled beryllium oxide compacts for reactor use. Separate abstracts have been prepared for all of the papers. (D.L.C.)

19861 (TID-7603) PROCEEDINGS OF THE URANIUM CARBIDE MEETING HELD AT OAK RIDGE NATIONAL LAB., DECEMBER 1 AND 2, 1960. (Oak Ridge National Lab., Tenn.). 154p.

Eighteen papers presented at the Uranium Carbide Meeting are given. Separate abstracts were prepared for each paper. (M.C.G.)

19862 (TID-7603(p.4-11)) PROGRESS IN URANIUM CARBIDE TECHNOLOGY AT ATOMICS INTERNATIONAL. D. I. Sinizer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Arc- and skull-casting techniques for fabricating UC are discussed. Work was continued on preparation of fuel elements containing packed UC powder. Pellets of fine-grained stoichiometric UC were prepared by warm pressing of U and graphite. An attempt was made to produce UC single crystals. Arc-cast UC exposed for 1000 hr in Santowax R at 750°F broke into several pieces. In irradiation tests fission gas was lost through cracks in the stainless steel thermocouple sheath. Contact couple studies were used for development of phase diagrams and study of elevated-temperature behavior during melting and casting. Rapid diffusion of carbon was observed in UC–UC_2 couples held at 3100°F for 2 hr. under 2000 psi. UC was reduced by Ta at 2300°F and by zr at 2200°F. Particles and pieces of UC slugs were heated in vacuum for 2 hr at 825°F and exposed to air. No explosion or sustained pyrophoric reaction was observed. The irradiation program for UC is summarized. (M.C.G.)

19863 (TID-7603(p.12-24)) RESEARCH ON URANIUM CARBIDE AND URANIUM CARBIDE-BASE FUEL MATERIALS AT BATTELLE MEMORIAL INSTITUTE. Walston Chubb and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio).

Cold pressing and sintering resulted in UC compacts having densities of over 90% theoretical only in those cases where excess metallic U was present. Hot pressing resulted in the consolidation of powders to densities of nearly 100% theoretical. Homogeneous single and multiple castings weighing up to about 5 kg were made by skull casting. Mechanical-property tests of UC disclosed a maximum in strength, hardness, and corrosion resistance at about 7 wt.% C. The effects of heat treatments on carbides with various amounts of C were determined. Alloys of U and C were prepared containing Al, Cr, Fe, Mn, Mo, Ni, Nb, Ta, Ti, W, V, and Zr. The effects of these additions on mechanical properties and corrosion resistance were investigated. The rates of interdiffusion of U and V in uranium carbides were studied. The effects of irradiation on the carbides are being determined. (M.C.G.)

19864 (TID-7603(p.25)) RESEARCH ON URANIUM CARBIDE AT BROOKHAVEN NATIONAL LABORATORY. Allan Auskern (Brookhaven National Lab., Upton, N. Y.).

UC was prepared by the reaction of methane with U metal. Apparatus for the collection of fission gas evolved from isothermal anneals of slightly irradiated UC powders is under construction. Preliminary experiments were carried out on the formation of UC from the reaction of U and hydrocarbon gases at room temperature in a gamma field. (M.C.G.)

19865 (TID-7603(p.26-33)) STATUS OF CARBIDE FUEL DEVELOPMENT AT THE CARBORUNDUM COMPANY. K. M. Taylor (Carborundum Co., Niagara Falls, N. Y.).

UC was prepared mainly by carbon reduction of UO_2. The pelletizing of the reaction mix prior to furnacing was omitted. Studies were continued on the preparation of UC by the reaction of ammonium diuranate and carbon. For fabrication of UC fuel pellets, cold pressing and sintering were used. The addition of uranium to UC powder prior to sintering was not especially effective in improving the density of the sintered pellets. Work was begun on the determination of physical properties of UC. The cost of producing UC clinker on a commercial basis by the carbon reduction of UO_2 was estimated to be about $2.00 per pound plus the cost of materials. A facility for the synthesis and fabrication of UC–PuC fuels is described. (M.C.G.)

19866 (TID-7603(p.34-44)) CARBIDE RESEARCH AT GENERAL ATOMIC. S. Langer and M. T. Simnad (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

The isothermal diffusion of uranium in a graphite matrix and the migration of uranium and thorium in fuel compacts subjected to a temperature gradient comparable to that expected in the High Temperature Gas Cooled Reactor were determined. The vapor pressures of uranium and thorium in equilibrium with their dicarbides and graphite are being measured by the Knudsen effusion technique. Apparatus for the thermal analysis of metal-carbon systems was designed and constructed. The release of Xe^{133} from irradiated samples of UC is being studied as a function of time and temperature. (M.C.G.)

19867 (TID-7603(p.45-7)) CARBIDE RESEARCH AT LAWRENCE RADIATION LABORATORY. Donald D. Jackson (California. Univ., Livermore. Lawrence Radiation Lab.).

The diffusion processes of metallic elements in graphite are being studied. Vapor pressure determinations on GdC_2 and ThC_2 were made using the direct Knudsen effusion method. (M.C.G.)

19868 (TID-7603(p.48-51)) STUDIES WITHIN THE SYSTEM UC–UC_2 AT LOS ALAMOS SCIENTIFIC LABORATORY. Willard G. Witteman, James M. Leitnaker, and Melvin G. Bowman (Los Alamos Scientific Lab., N. Mex.).

Phase and thermodynamic studies were carried out in the composition range between UC and UC_2. A solid-state transition in these compositions was investigated by means of high-temperature cooling curve analysis. A well defined thermal arrest at 1750 ± 20°C was found over almost the entire composition range. Preliminary measurements were made of the transport of uranium in equilibrium with the UC_2 phase and graphite. From the effusion rate data, dissociation pressures of U(gas) were computed by means of the Knudsen equation. Phases resulting from the dissolution of tungsten in the uranium carbides were investigated. (M.C.G.)

19869 (TID-7603(p.55-71)) NASA RESEARCH ON URANIUM CARBIDE AND REFRACTORY CERAMICS. John W. R. Creagh (National Aeronautics and Space Administration. Lewis Research Center, Cleveland).

The compatibility of UC with ZrC, NbC, W, and Ta was investigated by a metallurgical study of their contact surfaces. The specimens were mounted in bakelite and sectioned perpendicular to the contact face. Tungsten was found to be compatible to a higher temperature than tantalum. Whereas tantalum experienced appreciable reaction at 3900°F, tungsten was not affected at 4300°F. Niobium carbide was found to be superior to zirconium carbide. Reactions on the zirconium carbide contact face were observed at 4000°F; on the niobium carbide contact face only slight reaction occurred at 4500°F. (M.C.G.)

19870 (TID-7603(p.72-92)) GRAPHITE-MATRIX NUCLEAR FUEL ELEMENT DEVELOPMENT AT THE NATIONAL CARBON COMPANY. M. Janes (National Carbon Co. Research Labs., Cleveland).

The work carried out in development of graphite-matrix fuel elements produced by addition of UO_2 or ThO_2 to a carbonaceous mix, followed by blending, forming into a green shape, and baking. The final chemical form of the fuel is determined by the temperature and time at temperature in the final baking step. Irradiation tests were carried out on graphite-matrix elements encapsulated in low-permeability graphite. There was no indication of rupture or any gross distortion in the irradiated fuel demonstrating the resistance of the graphite matrix to thermal stress rupture. From the results of gamma spectrometry, the flow rate of the sweep gas, and an estimate of the time elapsed from emergence of the nuclide atoms from the encapsulating graphite to their reaching the sample position, a release rate through the graphite wall was calculated for each of the nuclides detected. (M.C.G.)

19871 (TID-7603(p.93-106)) CARBIDE FUEL DEVELOPMENT AT NUCLEAR DEVELOPMENT CORPORATION OF AMERICA. A. Strasser (Nuclear Development Corp. of America, White Plains, N. Y.).

Progress in a program to reduce the fuel cycle cost of converter and breeder reactors by the use of PuC-UC fuel is reported. Metallographic examination of enriched UC pellets showed excess metal near the surfaces of the pellet. Cladding materials were investigated and type 304 stainless steel, niobium, and chromium steel appeared to be satisfactory for cladding the fuel. The plutonium facility was completed. A survey of raw material costs was made. (M.C.G.)

19872 (TID-7603(p.107-13)) URANIUM CARBIDE RESEARCH AT THE OAK RIDGE NATIONAL LABORATORY. T. Hikido (Oak Ridge National Lab., Tenn.).

Progress in UC development is reported. Studies on arc-melting UC were directed toward developing techniques for preparing material with close compositional control in the shapes and sizes required. Graphite mold inserts are being studied to determine whether sound castings can be made and the extent of the reaction of the UC with the mold material. Preliminary tests were performed to determine the fabricability of UC bonded with U_3Si_2. A mass spectrometer was used to determine the species emitted from UC during vacuum sintering and their relative rates of emission. The reaction of UC with water at 80 to 90°C is being studied. UC_2 and LaC_2 were found to transform from the tetragonal to the cubic phase at room temperatures. (M.C.G.)

19873 (TID-7603(p.114-26)) DEVELOPMENT OF URANIUM CARBIDE AS A NUCLEAR FUEL AT OLIN MATHIESON CHEMICAL CORPORATION. Herbert S. Kalish and Felix B. Litton (Olin Mathieson Chemical Corp., New Haven).

The development of methods of making UC by the reaction of carburizing gas with uranium metal powder and the skull arc melting of a charge of prereacted or unreacted UO_2 graphite mixtures is reported. The gas used consisted of a 4-to-1 mixture of methane and hydrogen. Chemical analysis of the carbide powder produced by this method indicated a wide variability in C, O_2, and N_2 contents. The efficiency

of the reaction was about 70%. Data indicated that the reaction is not temperature dependent. Preliminary experiments using propane for carburizing uranium were very promising. Specimens of UC powder were compacted at 35 tsi in an argon atmosphere. Attempts to increase the sintered density of near-stoichiometric UC by increasing the sintering temperature to 2200°C resulted in excessive uranium volalitization. The skull melting attachment for melting UC is described. Arc melting of unreacted pellets in a button furnace was investigated. (M.C.G.)

19874 (TID-7603(p.147-59)) ADVANCES IN URANIUM CARBIDE TECHNOLOGY IN FRANCE. A. Accary (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay).

Uranium carbide was prepared by heat treating a mixture of powders of uranium and carbon in order to bring about both the formation of the carbide and densification into a solid body with a predetermined shape. Hot pressing was successfully applied to the preparation of UC_2 and U_2C_3. Spherical UC powder with a predetermined grain size was prepared by the disintegration of a U-UC cermet by reaction with hydrogen yielding a mixture of UC and UH_3 particles which could be separated by physical means. It was found that thermal stresses were sufficient to transform UC to U_2C_3. The reaction of UC with zirconium was investigated. The grain growth of hot-pressed UC was also studied. (M.C.G.)

19875 (TID-7603(p.160-2)) EXPERIMENTAL WORK ON URANIUM CARBIDE FUEL AT EURATOM-NUKEM. B. G. Liebmann (Nuklear Chemie und Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany).

The UO_2–graphite reaction was used to prepare UC by solid-state reaction, arc melting of UO_2-graphite mixtures, and arc melting of partly prereacted charges. Fabrication of UC was carried out by sintering, tamping, and swaging. (M.C.G.)

19876 (TID-12434) THE THERMAL CONDUCTIVITY OF CERAMIC DIELECTRICS. W. D. Kingery (Massachusetts Inst. of Tech., Cambridge). [1960?]. 94p.

The thermal conductivity of dielectric solids at various temperatures is discussed in terms of the mean-free path concept and its application to phonon- and photon-energy transfer. In single crystals and glasses, the effects of temperature, composition, structure, boundary conditions, impurities, solid solutions, and neutron irradiation are discussed. From these considerations the resultant conductivity is derived in terms of phase composition and microstructure. It is concluded that conduction processes are well understood, and that the conductivity of complex ceramics can be predicted if the chemical and physical composition are adequately described. (auth)

19877 (TID-12573) RESEARCH INTO THE DIFFUSION OF INERT GASES IN SOLID BODIES. Quarterly Report No. 2, October 1 to December 31, 1960. (Hahn-Meitner-Institut für [Kernforschung], Berlin). EURATOM Contract EUR/C/710/2/6od. AEC 66/EURATOM 114. 13p.

Results were obtained from tests with single crystals of KF using argon, which is to serve as a model system for the activation diffusion method and the testing of the Inthoff-Zimen theory. For pressed tablets of KF powders, the heating curve differed from that obtained for single crystals. The first measurements for UC and UO_2 systems were effected. Preliminary tests of the ThO_2 system indicated that the fission inert-gas activity obtainable upon irradiation was sufficient to permit carrying out the diffusion tests. (B.O.G.)

19878 (TID-12638) THE EFFECT OF RARE-EARTH ELEMENTS ON THE ALLOTROPIC TRANSFORMATION OF ZIRCONIUM. Final Report. James C. Uy, Daniel J. Lam, Louis Ianniello, Richard A. Proebstle, Albert P. Lee, Benjamin T. M. Loh, and Arthur A. Burr (Rensselaer Polytechnic Inst., Troy, N. Y.). Apr. 1961. Contract AT(30-1)-2159. 92p.

The effect of rare-earth elements on the allotropic transformation of zirconium was studied in terms of its thermodynamic and its electronic nature. The alloy specimens were prepared by vacuum arc melting and cold worked to size. As major tools of investigation, metallography, dilatometry, and electrical resistivity were employed. Thermodynamic equations were derived to calculate the theoretical phase boundaries. Then both experimental and theoretical results were compared and considered in necessary detail. In addition, the allotropy of zirconium was considered from the point of view of the effect of temperature on the Fermi energy level. Finally, in addition to the partial phase diagrams, the complete zirconium–yttrium diagram was determined. (auth)

19879 (TID-12713) FRICTION AND SURFACE DAMAGE, STUDY OF HIGH TEMPERATURE ALLOYS AT TEMPERATURES UP TO 1800°F. W. M. Garcia (General Electric Co. Flight Propulsion Lab. Dept., Evendale, Ohio). Dec. 7, 1960. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contracts AF 33 (600)-38062 and AT(11-1)-171. 91p. (XDC-61-3-129; R60FPD619)

Sliding tests were performed on six high temperature alloys. Nineteen combinations were tested including evaluation of several coated specimens. Testing consisted of thermal cycling to 1600 and 1800°F using a slow speed friction tester. Sliding was performed at several temperatures during heating and cooling cycles. (auth)

19880 (TID-12721) BERYLLIUM OXIDE STUDIES. R. Cooperstein (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 29, 1959. 73p. (DC-59-9-215).

Work in progress with beryllium oxide is described. The methods for producing beryllium oxide and analytical data are presented for the various oxide powders formed. Results of calcination and sintering studies are presented and discussed, and suggestions for additional studies to be performed are included. (auth)

19881 (TID-12738) PROPERTIES OF LITHIUM HYDRIDE. I. VISCOSITY OF LIQUID LITHIUM HYDRIDE FROM 1252F TO 1578F. Frank H. Welch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati), H. W. Northrup, W. H. Mink, and A. W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). Mar. 16, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 17p. (XDC-61-4-59)

This report presents the viscosity measurements phase of the work as reported by Battelle Memorial Inst., Feb. 28, 1961, under Subcontract AT-5-722.

A closed system utilizing a Brookfield viscometer was designed for measuring the viscosity of LiH at 1252 to 1578°F. The system was operated under hydrogen at 20 psig with provisions for external control of the furnace and viscometer. The viscosity varied little and appeared to be described by a straight line between 0.37 centipoises at 1252°F and 0.24 centipoises at 1570°F. The LiH evidently melted at ~1252°F, which is 10° lower than the reported value. (auth)

19882 (TID-12831) STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON–ALUMINUM ALLOYS. Twelfth

Monthly Letter Report, May 1, 1960 to April 30, 1961. George P. Rauscher, Jr. and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). May 12, 1961. Contract AT(11-1)-742. 7p.

A study was made of the long-range order parameter for the Fe_3Al ordered phase in the binary 13.9- and 16-Alfenol alloys. A single crystal of each composition was grown by the strain-anneal technique and slow cooled from 700 to 100°C at the rate of 5°/hr. The integrated intensities of three superlattice reflections for each crystal were determined by x-ray diffraction studies. Subsequently, the perfectly ordered crystals were isothermally annealed to produce an equilibrium degree of order corresponding to a constant resistivity condition and then rapidly quenched in an iced brine solution. The integrated intensities of the superlattice reflections were then determined as before. By repeating the procedure, a curve of the equilibrium value of long-range order parameter as a function of temperature was obtained for each alloy. (M.C.G.)

19883 (USBM-U-819) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 10 FOR THE PERIOD OF JANUARY 1, 1961 TO MARCH 31, 1961. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 27p.

High-purity thorium metal was prepared by the reaction of sodium metal with thorium tetrachloride. This reaction may be carried out successfully in either 8-inch or 14-inch diameter retorts. Purity of the product metal is directly dependent on the purity of the reactants, particularly with respect to the thorium tetrachloride. For this reason, considerable emphasis was placed on developing methods of preparing and purifying the chloride. The evaluation of boron nitride as a crucible material for the Mg reduction of UF_6 was continued. Because of corrosion problems associated with the reduction of UF_6, the development of a Kroll-type reduction of UF_4 was initiated. An enriched solution containing 10% Hf can be produced by fractional crystallization of complexed fluosalts of Zr and Hf. A 75% recovery of enriched Hf can be obtained with present techniques. During reactions of Zr–Hf tetrachloride mixtures with Zr metal turnings at 340 to 450°C, maximum enrichments of Hf occur in the vicinity of 375°C. Work during the quarter consisted of detailed metallographic and parametric analyses of Hf–Ta alloys, and of metallographic and melting point studies on Hf–V alloys near the HfV_2 composition. In the former, the main results are the location of the Hf solvus around 6% and the Ta solvus around 10%, both at approximately 1,000°C. In the latter, the main findings are 1,450°C and 1,490°C solidus isotherms, respectively, on the Hf and V-rich sides of HfV_2. The Fe–Gd phase diagram and the Ni–Gd phase diagram investigations were completed. The investigation of the Cr–Gd phase diagram is nearly complete. The investigation of ternary alloys of Fe, Cr, and Gd was completed. During the reporting period, eight Ta ingots were cast with controlled additions of C, O, and N. The ingots were cold-rolled to produce sheet specimens for welding tests. The integrity of the welds was determined by metallographic examination, microhardness measurements, and bend tests. Several $3\frac{1}{2} \times 10$ in. Zr and Mo ingots were cast in two types of finned crucibles. Presently, it is postulated that the maximum crucible diameter will be 10 in. Purification of metals as a function of residence time in the molten state as it relates to electron-beam melting was studied by melting buttons of Zr, Hf, Nb, V, and Be. No valid conclusions were reached. Los Alamos Scientific Laboratory determined that locally prepared high-purity hafnium carbide has a NaCl-type cubic lattice averaging 4.6429 ± 0.0006 A. (auth)

19884 (WADD-TR-60-278) NOTCH SENSITIVITY OF REFRACTORY METALS. Albert G. Imgram, Frank C. Holden, Horace R. Ogden, and Robert I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Sept. 1960. 121p. Contract AF33(616)-6291. (PB-171198)

The tensile and notch tensile properties of molybdenum, tungsten, niobium, tantalum, and Mo-0.5Ti, were investigated at five temperatures selected to encompass the brittle-to-ductile transition. All specimen failures were classified according to fracture mechanism. The notch sensitivity of each material was evaluated by analyzing the notch and unnotch tensile strength, the ductility transition, and the fracture transition. (auth)

19885 (WADD-TR-60-410(Pt.I)) INVESTIGATION OF THERMAL EFFECTS ON STRUCTURAL FATIGUE. Douglas Aircraft Co., Inc., Santa Monica, Calif.). Aug. 1960. Contract AF33(616)-6571. 204p. (AD-249130)

A procedure for design of structures fatigue–resistant in an elevated temperature environment is presented. Constant load amplitude and spectrum fatigue tests were run on notched and unnotched molybdenum and stainless steels at temperatures up to 800°F. The hydraulic spectrum loader is described. Methods of accounting for non-linear damage propagation and large preloads were developed. A digital computer program based on these methods is presented. The test spectrum fatigue lives were compared with predictions by cumulative damage analyses. These analyses included Miner's linear damage theory as well as several non-linear damage theories. (auth)

19886 (AEC-tr-3971(p.237-85)) DIFFUSIVE POROSITY IN METALS AND ALLOYS. Ya. E. Geguzin. Translated from Uspekhi Fiz. Nauk, 61: No. 2, 217-47(1957).

The experimental investigations of the appearance of diffusive porosity and some phenomena accompanying this process are reviewed. Diffusive porosity, appearing in the course of mutual diffusion of metals, which form solid solutions of substitution, supersaturation of crystalline lattice with vacancies, diffusive porosity in monocomponent systems, the generation of diffusive pores, and the diffusive porosity and sintering of mixtures of metallic powders are discussed. In all cases considered, the process of the formation of diffusive porosity caused by a decrease of the free energy of a system remote from a state of thermodynamical equilibrium was a stage on the way to the establishment of a true equilibrium state in the sample. (M.C.G.)

19887 (AEC-tr-3971(p.287-332)) THE STRUCTURE OF LIQUID METALS. I. V. Radchenko. Translated from Uspekhi Fiz. Nauk, 61: No. 2, 249-76(1957).

On the basis of the data from x-ray and neutron diffraction studies, it was determined that the packing of atoms in a liquid metal is related in a certain manner with the packing in the solid state. The character of this relation depends on the kind of metal. The characteristics of the arrangement of atoms in liquids are the average coordination number and the most probable radius of the coordination sphere. The experimental conditions necessary for x-ray studies of liquid metals are discussed. Results of structure studies of liquid metals are given for Hg, Au, Pb, Tl, In, Cd, Al, Zn, Na, K, Li, Rb, Cs, Ga, Bi, Ge, Sb, Se, Te, and Sn. (M.C.G.)

19888 (AEC-tr-4062(p.127-34)) FUSION DIAGRAM OF THE SYSTEM TITANIUM–VANADIUM–NIOBIUM. I. I. Kornilov and V. S. Vlasov. Translated from Zhur. Neorg. Khim., 2: No. 12, 2762-5(1957).

The solidus area of the ternary Ti–V–Nb system was explored by the use of a W–Ta thermocouple. The data obtained showed smooth variations of fusion temperatures with composition. Thermal analysis indicated that the alloys of the Ti–V–Nb system crystallize as continuous solid solutions. The minimum in the fusion diagram of the V–Nb binary system corresponded to the depressions in the fusion diagram of the Ti–V–Nb system. A spatial representation of the fusion diagram of the ternary system is included. (M.C.G.)

19889 (AEC-tr-4403) SPECTRA OF THE RARE EARTHS. (Spektry Redkikh Zemel). M. A. El'yashevich. Translated from publication of the State Publishing House of Technical-Theoretical Literature, Moscow, 1953. 590p.

Issued in two books.

The problems of spectroscopy of the lanthanide elements, thorium, and uranium are reviewed. In addition to the free atom, the spectra of ions in crystals and solutions are considered. (B.O.G.)

19890 (AEC-tr-4566) ON THE PROBLEM CONCERNING THE NATURE OF SIGMA PHASE. N. V. Ageev (Ageyev) and V. Sh. Shekhtman. Translated by Lydia Venters (Argonne National Lab.) from Doklady Akad. Nauk S.S.S.R., 135: 309-11(1960). 5p.

X-ray-diffraction studies were carried out for σ-phase ordering in Cr–Re, Fe–Re, and Mn–Re alloys. The variations are tabulated of the ordered arrangement of the atoms in the compounds, $Re_{18}Cr_{12}$, $Re_{12}Fe_{18}$, and $Re_{16}Mn_{14}$, that satisfy the symmetries of the spatial group $P4_2/mnm$, to which the σ-phase structure is referred. Calculations were made of intensities for reflections related to a group of 6 intense lines, which show that, in the majority of cases according to the relation of the intensities of the chosen lines, the statistical distribution of atoms could be distinguished and a definite ordering scheme could be found. Analyses of the selected ordering schemes indicate that the distribution of atoms manifests correlation with the coordination number. It is shown, by a plot of the rhenium concentration in the phases V–Re, Cr–Re, Mn–Re, and Fe–Re as a function of the group number of the second component, that as the group number increases a smaller amount of rhenium is required for attaining the electron concentration, characteristic of σ-phases. (B.O.G.)

19891 (AEC-tr-4619) ON THE STRUCTURE AND THERMAL EXPANSION OF δ- AND η-PLUTONIUM. S. T. Konobeevskii and N. T. Chebotarev. Translated from Atomnaya Energ., 10: 50-7(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 9451.

19892 (AEC-tr-4620) THE RELATION BETWEEN STRUCTURE AND ANISOTROPY OF THERMAL EXPANSION IN URANIUM, NEPTUNIUM, AND PLUTONIUM. N. T. Chebotarev. Translated from At. Energ. (U.S.S.R.), 10: 43-9(1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 9450.

19893 (CEA-tr-A-832) L'INFLUENCE DES TRAITEMENTS THERMIQUES SUR QUELQUESUNES DES PROPRIÉTÉS DES ALLIAGES AU NICKEL-MOLYBDÈNE RÉSISTANTS A LA CORROSION. (Effects of Heat Treatments on Some of the Properties of Corrosion-resistant Molybdenum–Nickel Alloys). K. Bungardt and H. H. Weigand. Translated into French from Z. Metallk., 50: No. 1, 11-18(1959). 28p.

The effect of heat treatments on structure, hardness, mechanical properties, and corrosion was studied on four corrosion-resistant Ni–Mo alloys, two containing Cr and two containing no Cr. The results show that precipitations, which form a continuous band for short anneals and which coagulated for long anneals, are produced after annealing between 700 and 1100°. In the two alloys without Cr, the formation of two intermetallic phases was observed. For all the alloys a clear augmentation of the hardness was only found when large precipitations were observed in the structure. An increase of the temperature of diffusion anneal limits the increase of the hardness during further heatings when precipitations have occurred. Compression and stretch to rupture decreases sharply during heating when precipitations have occurred, whereas the elastic limit and resistance to pull increase slightly. The resistance to corrosion in the precipitation region is greatly influenced by the anneal. The molybdenum concentration also affects corrosion resistance. (tr-auth)

19894 (CEA-tr-A-856) LA DIFFUSION DU ^{133}Xe DANS L'OXYDE D'URANIUM A DIFFÉRENTES TENEURS EN OXYGENE. (The Diffusion of Xe^{133} in Uranium Oxide at Different Oxygen Concentrations). R. Lindner and Hj. Matzke. Z. Naturforsch., 14a: 582-4(1959). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract no. 17909.

19895 (NASA-TT-F-64) THE SINTERED COPPER POWDER. E. (Ye.) M. Savitskii (Savitskiy) and A. I. Vlasor. Translated from Tsvetnye Metally, 33: No. 7, 72-7(1960). 8p.

The structure, resistivity, oxidation resistance, mechanical properties, and manufacturing processes of sintered copper powder are studied when alumina, silica, or magnesia is added. With addition of Al_2O_3 powder to sintered copper powder the strength is 50% and the hardness 100 to 200% higher than those of copper at temperatures of 20° to 800°C; the recrystallization temperature is shifted from 300 to 600° to 700°C. The electrical conductivity with 1 to 3% Al_2O_3 by volume is 87 to 93% that of copper, while oxidation resistance is higher. The strength and hardness of the sintered product increase when very finely powdered Al_2O_3 is used. (auth)

19896 (UCRL-Trans-660(L)) APPLICATION OF THE THEORY OF SHOCK WAVES TO DESCRIBE THE PROCESS OF MARTENSITE CRYSTAL GROWTH. F. L. Lokshin. Translated from Nauch. Doklady Vysshei Shkoly, Met., No. 1, 146-50(1959). 15p.

Previous methods showed that, in steel, the rate of growth of the martensite crystals is approximately equal to 6500 m/sec., which is greater than the speed of sound in steel. Therefore, on examining the growth of the crystal as a process of expansion of a shock wave, the concept of a "strong" shock wave was used. It was shown that with a dynamic austenite compression, martensite conversion takes place at the time when the pressure, on dynamic compression, reaches a certain critical magnitude. After martensite is formed in a strongly compressed state, in striving to expand it compresses the austinite layer adjacent to it. When the pressure on this layer becomes equal to or greater than the critical one, a martensite conversion takes place. This wave process was investigated by applying the theory of shock waves. (M.C.G.)

19897 (UCRL-Trans-665(L)) GROWTH RATE OF THE MARTENSITIC CRYSTAL. A. N. Alfimov and A. P. Guliaev. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 3, 88-90(1954). 8p.

The formation time of the martensite crystal was measured by means of a cathode-ray oscilloscope. The speci-

men, together with a piezoquartz plate attached to it, was cooled in the vapors of liquid nitrogen. The formation time of the martensite crystal was determined by the time of the existence of a pressure pulse which formed as a result of the formation of a relief on the polished surface during martensitic transformation. This pulse was transformed by the piezoelement into an electric pulse which could be seen on the screen of the oscilloscope. The pulse length was compared with the length of the calibration pulse of the 26-I generator having a duration of 0.1 μsec. In all instances, the pulse during transformation was smaller than the duration of the calibration pulse. Thus it is only possible to assert that the formation time of the martensite crystal is less than 1×10^{-7} sec. (M.C.G.)

19898 NUCLEAR MATERIALS. M. Salesse (CEA, Paris). Atomwirtschaft, 6: 225-9(Apr. 1961). (In German)

A survey is made of the properties and applications of various reactor construction materials such as beryllium, magnesium, aluminum, zirconium, and steel and of fuel materials such as metallic uranium and its alloys, UO_2, and cermets. (J.S.R.)

19899 MODERATORS. P. Leveque (CEA, Saclay, France). Atomwirtschaft, 6: 230-3(Apr. 1961). (In German)

Efforts made in France to produce nuclear graphite economically are reviewed. The preparation, properties, and shaping of graphite are discussed. The investigation on organic moderators is also briefly considered. (J.S.R.)

19900 DETERMINATION OF THE SLIP ELEMENTS BY ANALYSIS OF THE ASTERISMS OF LAUE SPOTS AND DEFORMATION MODES OF BERYLLIUM AT HIGH TEMPERATURE. Pierre Pointu, Pierre Azou, and Paul Bastien. Compt. rend., 252: 1984-6(Mar. 27, 1961). (In French)

Some asterisms of Laue spots are supposed to arise from a curve around a Taylor axis. This is verified for hexagonal metals, and new modes of deformation are determined for beryllium at high temperature. (tr-auth)

19901 INFLUENCE OF TEMPERATURE ON INTEGRATED INTENSITY OF (200) REFLECTION OF PURE Al. K. Toman (Inst. of Technical Physics. Academy of Sciences, Prague). Czechoslov. J. Phys., 11: 186-92(1961). (In English)

The temperature dependence of the intensity and reflecting range of the (200) reflection of x rays on an aluminum crystal exhibiting strong primary extinction was studied. It was found that the observed temperature dependence cannot be approximated by the Debye-Waller factor. The reversible change in the system of imperfections in the crystal is suggested and discussed as a mechanism qualitatively explaining the observed phenomena. (auth)

19902 THE OCCURRENCE OF A p-n TRANSITION OF CARBON–GRAPHITE MATERIALS. A. S. Fialkov and Ya. G. Davidovish. Doklady Akad. Nauk S.S.S.R., 137: 841-3(Apr. 1, 1961). (In Russian)

Since a change in sign of conductivity is observed in different types of charcoal during prolonged temperature treatment, there is reason to believe that p-n transitions occur because of the formation of acceptor-donor impurities during the thermal treatment. Samples of charcoal were subjected to thermal treatment by holding for 5 minutes at 1200 to 3200°C in an argon atmosphere in a furnace with a graphite heater. Measurements of the Hall coefficient and of the specific electrical resistance were then made on $3 \times 7 \times 28$ mm samples of the charcoal at room temperature. The maximum value of p-conductivity was observed at a treatment temperature of 2200°C. A two-stage thermal treatment at two different temperatures was used to create a p-n transition. The presence of a p-n transition in one sample was verified from the changes in the Hall coefficient from which the concentration of carriers along the length of the sample was calculated. The width of the p-n transition is determined by the type of thermal treatment. The changes in the thermal electromotive force with temperature are presented for two carbon-graphite thermocouples. One thermocouple shows a change of 0 to 30 mvolts for the temperature range of 0 to 1600°C, and the other 0 to 16 mvolts for the temperature range of 1000 to 2800°C. These data indicate that carbon-graphite thermoelements can be used over a wide range of temperatures in high-temperature work. (TTT)

19903 AN INVESTIGATION OF THE NATURE OF A CHEMICAL COMPOUND IN THE Ti–Si SYSTEM. R. B. Golubtsova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 859-61 (Apr. 1, 1961). (In Russian)

Annealed samples of Ti–Si alloys with 0.25 to 7.5 wt.% Si were subjected to anodic dissolution for 1.5 hrs at a current density of 0.03 to 0.05 amps/cm^2 in an electrolyte containing 15 ml H_2SO_4 (sp.gr. = 1.84), 3.0 g of ascorbic acid and 1000 ml of methyl alcohol. The insoluble anodic residue was found to correspond to the composition Ti_5Si_3 in all cases as determined from the results of chemical and x-ray analyses. The material balance of the electrolysis products compared to the weight loss of the anode was 99% (wt. loss of the anode was 0.6144 g compared to 0.6093 g of Ti and Si accounted for in the electrolysis products). Up to this time there has been no electrolyte reported in the literature that is suitable for the anodic dissolution and isolation of intermetallic titanium silicides from titanium alloys. (TTT)

19904 COOLING BY LIQUID METALS. PROBLEMS OF COMPATIBILITY. R. Darras (Commissariat à l'Energie Atomique, [Paris]). Energie nucleaire (France), 3: 128-38(Mar.-Apr. 1961). (In French)

The properties of liquid metals as coolants are reviewed; corrosion and structural problems encountered in the use of these liquid metals are discussed. Purification and oxygen content control are considered, especially in the case of Na and Na-K alloys. (auth)

19905 SINTERING BEHAVIOR OF BERYLLIUM OXIDE. E. J. Felten (General Electric Co., Schenectady, N. Y.). J. Am. Ceram. Soc., 44: 251-5(June 1961).

The sintering behavior of BeO in a reducing atmosphere was studied between 1500 and 2100°C. Above 1700°C the firing temperature had only a small effect on the density after heating for 24 hours. At 1700°C during the first 3 to 5 hours there was a large increase in the density of the body accompanied by a simultaneous rapid rate of grain growth. Firing for longer times resulted in more moderate increases in both density and grain growth. The grain-growth characteristics were unchanged by most oxide additions although compacts of higher density resulted. Oxide additives which formed a liquid phase at the sintering temperature enhanced both the sinterability and grain growth of beryllia. (auth)

19906 HIGH-TEMPERATURE PHASE STUDIES IN THE TANTALUM–BORON SYSTEM BETWEEN Ta AND TaB. James M. Leitnaker (Los Alamos Scientific Lab., N. Mex.), Melvin G. Bowman, and Paul W. Gilles. J. Electrochem. Soc., 108: 568-72(June 1961).

Phase relationships in the tantalum-boron system between Ta and TaB are studied. A phase diagram of the

solid portion of the system is determined and is shown. Two three-phase equilibria exist within the system: $Ta-Ta_2B-Ta_3B_2$ at 2040° ± 30°C, and $Ta_2B-Ta_3B_2-TaB$ at 2180° ± 20°C. The chemical composition of the Ta_2B phase is $Ta_{2.4\pm0.2}B$. The composition of the Ta_3B_2 phase is $Ta_{1.60\pm0.05}B$. The melting point of TaB lies above 2800°C. The extreme slowness of reactions within the system is investigated qualitatively, and the necessity for seeding at temperatures in the neighborhood of 2000°C is noted. The results disagree markedly with data previously reported in the literature. (auth)

19907 A NOTE ON THE DUCTILITY OF BERYLLIUM SINGLE CRYSTALS ORIENTED FOR BASAL SLIP AND TESTED IN TENSION. M. Herman and G. E. Spangler (Franklin Inst. Labs., Philadelphia). J. Franklin Inst., 271: 421-2(May 1961).

An experiment is described in which Be single crystals are subjected to bending tests. It is found that the basal glide mechanism contributes appreciably to the bending. Further, the yielding shear stress decreases with increasing crystal purity. The Be samples are zone melted, and the purity is dependent on the number of passes of the sample in the zone melting apparatus. (T.F.H.)

19908 LIQUIDUS-SOLIDUS RELATIONS IN IRON-RICH IRON-NIOBIUM AND IRON-MOLYBDENUM ALLOYS. W. S. Gibson, J. R. Lee, and W. Hume-Rothery (Univ. of Oxford). J. Iron Steel Inst. (London), 198: 64-6 (May 1961).

The liquidus and solidus relations in iron-rich alloys of the systems iron-niobium and iron-molybdenum are determined for alloys of high purity. Some information is gained of the constitution of the alloys in the solid state. For the system Fe-Nb, the general form of the earlier diagram is confirmed, but the composition of the δ-eutectoid is at a lower percentage of niobium than was previously imagined. For the system Fe-Mo, the general form of the earlier diagram is again confirmed, but the freezing range of the δ-phase alloys is narrower than was previously supposed. In the systems Fe-Cr and Fe-Mo the δ-liquidus and solidus curves pass through minima at almost the same composition (c. 20 at.% solute) in spite of the larger size of the molybdenum atom. (auth)

19909 SOME FEATURES OF THE REFRACTORY METALS. L. Northcott (Armanent Research and Development Establishment, Fort Halstead, Eng.). J. Less-Common Metals, 3: 125-48(Apr. 1961). (In English)

For engineering purposes the question of cost and availability limits the field of high mp metals to Nb, Ta, Mo, and W. The significance of the bcc structure and the factors affecting the ductile-to-brittle transition are discussed. These metals are mutually soluble but intermetallic compounds are formed with other metals. Reference is made to the excellent properties of the 35% Re alloys. A brief review of the oxidation properties suggests that protective coatings will be required where oxidizing conditions are present. Reference is made to mechanical properties, ingot preparation, and future developments. (auth)

19910 A STUDY OF THE EFFECT OF COOLING RATE ON THE DECOMPOSITION OF THE γ-PHASE IN URANIUM-LOW MOLYBDENUM ALLOYS. R. F. Hills (Atomic Energy Research Establishment, Harwell, Berks, Eng.), B. R. Butcher, and J. A. Heywood. J. Less-Common Metals, 3: 155-69(Apr. 1961). (AERE-R-3563). (In English)

The transformations that take place when U-Mo alloys are cooled at various rates from the γ-phase field were studied for a range of compositions by an end-quenching technique. A number of metastable phases were observed. A tentative explanation is offered to account for the transformation sequence in each alloy.

19911 HOT HARDNESS TESTING APPLIED TO THE AGEING AND HEAT TREATMENT OF BERYLLIUM. R. Thomson (Babcock & Wilcox, Ltd., Renfrew, Scotland), B. Begley, and A. J. Martin. J. Less-Common Metals, 3: 170-8(Apr. 1961). (In English)

A brief description of the apparatus is included. Sections from extruded rod, produced from thermally reduced pebble metal ingot and from electrolytically reduced flake metal ingot, were tested at temperatures up to 600°C. Results show that pebble metal exhibits both strain and precipitation ageing mechanisms, these being removed by precipitation annealing between 600 and 800°C with consequent improvement in high temperature ductility characteristics. No such phenomena were detected in flake material. (auth)

19912 THE SYSTEM THORIUM-YTTERBIUM: ITS ALLOY PROPERTIES. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). J. Less-Common Metals, 3: 179-80(Apr. 1961). (In English)

The thorium-ytterbium system is compared with the thorium-cerium system. Iodide thorium and ytterbium raw materials were used. The arc melting process for alloying was unsuccessful, however, after complete melting several specimens were obtained. One specimen was annealed for several days at 675°C. Diffraction patterns showed that the α-thorium spacing increased from 5.0745 kx for sure thorium to 5.0761 ± 0.002 kx; ytterbium decreased from 5.4750 kx to 5.4740 ± 0.0003 kx. There was no evidence of an intermediate phase. Restriction of solubility is probably connected with differences in electronic constitution. (P.C.H.)

19913 TEMPERATURE DEPENDENCE OF ELASTIC CONSTANTS OF SOME CERMET SPECIMENS. Sam Spinner. J. Research Natl. Bur. Standards, 65C: 89-96 (Apr.-June 1961).

The temperature dependence of Young's and shear moduli of four types of cermet specimens, known as "nickel-bonded titanium carbide," as well as Ni and TiC were determined by a dynamic resonance method. The Young's modulus temperature curves of the cermets are characterized by a linear decrease from room temperature until about 700 to 1,000°C. In this upper temperature region, an inflection in the relation develops, accompanied by an increase in internal friction. Both these effects are attributed to viscous grain boundary slip. For shear modulus, only the linear portion of the modulus temperature relation was obtained. In this linear region, the relative decrease in shear modulus for the cermet specimens is greater than the relative decrease in Young's modulus for the same type of specimen. This means that Poisson's ratio rises with temperature for the cermets. (auth)

19914 THERMAL CONDUCTIVITY OF UO_2 IMPROVES AT HIGH TEMPERATURES. J. Lambert Bates (General Electric Co., Richland, Wash.). Nucleonics, 19: No. 6, 83-5(June 1961). (HW-SA-2029)

The thermal conductivity (k) of sintered UO_2 is studied from 300 to 3000°K. The value of k decreases with temperature up to 1100°C, but at 1400°C and above the value of k increases with temperature. A theoretical explanation of this increase is given. (T.F.H.)

19915 PARAMAGNETIC RESONANCE SPECTRA OF f^3 IONS IN A CUBIC SITE. G. Vincow and W. Low (Hebrew Univ., Jerusalem). Phys. Rev., 122: 1390-2(June 1, 1961).

The paramagnetic resonance spectra of Nd^{3+} and U^{3+} in

the cubic field of CaF_2 are investigated at 3-cm wavelength at 20°K. In the case of Nd^{3+}, transitions within the lowest quartet Γ_8 and possibly in the next higher quartet Γ_8 are observed. The angular behavior conforms with that predicted by the spin Hamiltonian of a Γ_8 state. In the case of U^{3+} there are considerable deviations of the experimental g values from the calculated ones. It is suggested that these deviations are caused by the stronger cubic field. The efficiency of the thermal conversion from axial to cubic site is discussed. Additional lines suggest a new axial center along the [111] direction. (auth)

19916 PHONON SCATTERING IN SODIUM CHLORIDE CONTAINING OXYGEN. Miles V. Klein (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 122: 1393-1402(June 1, 1961).

The thermal conductivity of supposedly pure NaCl crystals from several sources was found to vary by as much as two orders of magnitude at low temperatures. This effect was quantitatively related to the presence of an ultraviolet absorption band at 185 mμ known to be caused by oxygen-containing anionic impurities. Both phenomena were considerably reduced by treatment of the crystals in chlorine vapor at high temperatures; conversely both were enhanced by growing crystals from melts doped with NaOH, NaOD, and Na_2O_2. There was little evidence, however, that the dopants appeared in these forms in the crystals. Infrared measurements and pH titrations suggested that the most likely result of the dopings was to introduce carbonate into the crystals. The active impurity scattered phonons very strongly at low temperatures; at 5°K approximately 3000 times more strongly than is usually observed for point defects. The cross section was proportional to the first power of the phonon wave vector and was found to be independent of the defect concentration. No detailed model was found to explain these results. A likely explanation would be in terms of an interaction between the phonon field and localized modes of the scattering center. (auth)

19917 MAGNETIC STRUCTURE OF CHROMIUM SELENIDE. L. M. Corliss, N. Elliott, J. M. Hastings, and R. L. Sass (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 122: 1402-6(June 1, 1961). (BNL-5209)

The magnetic structure of the NiAs-type compound, CrSe, is determined by means of neutron diffraction. The indexing of superstructure lines which appear below the Néel point requires a unit cell three times as large as the conventional unit ($a = \sqrt{3}a_{NiAs}$). Planes parallel to the basal plane contain three chromium atoms whose spins form an "umbrella"-like array with threefold symmetry. Individual moments alternate in sign along lines parallel to the c axis. A value of 2.90 μ_B is deduced for the component of the chromium moment perpendicular to the c axis. (auth)

19918 NEUTRON DIFFRACTION INVESTIGATIONS OF METALLIC CERIUM AT LOW TEMPERATURES. M. K. Wilkinson, H. R. Child, C. J. McHargue, W. C. Koehler, and E. O. Wollan (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 1409-13(June 1, 1961).

Neutron diffraction experiments on metallic cerium between room temperature and 4.2°K clarify the anomalous behavior observed in previous specific-heat and magnetic-susceptibility measurements. Results on three samples show that the magnetic behavior can be correlated with the three crystallographic phases present in the samples. There is a change in the electronic configuration of the cerium atoms when the collapsed face-centered cubic phase is formed, and antiferromagnetic ordering occurs in the hexagonal close-packed phase at about 12.5°K. (auth)

19919 HYPERFINE STRUCTURE OF Fe^{57} IN YTTRIUM–IRON GARNET FROM THE MÖSSBAUER EFFECT. C. Alff and G. K. Wertheim (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 122: 1414-17 (June 1, 1961).

The hyperfine structure of Fe^{57} in yttrium-iron garnet $[Y_3Fe_2(FeO_4)_3]$ is obtained through the Mössbauer effect. A 0.002 in. thick slice of a single crystal of yttrium-iron garnet, cut normal to a [110] direction, is used as an absorber of recoil-free gamma rays emitted by a stainless steel source. The iron in yttrium-iron garnet is located in two nonequivalent sites, tetrahedral and octahedral, each of which has an axially symmetric electric field gradient. Data are taken with the magnetization aligned in a [111] and in a [100] direction in order to produce the simplest absorption pattern. For each direction of magnetization, the absorption lines of Fe^{57} at both sites are resolved. The magnetic field at an Fe^{57} nucleus is found to be 3.9×10^5 gauss at a tetrahedral site and 4.7×10^5 gauss at an octahedral site at room temperature (~300°K). The quadrupole coupling is found to be 7.5×10^{-8} ev in the tetrahedral site and 9.0×10^{-8} ev in the octahedral site. (auth)

19920 STUDY OF THE LOW-TEMPERATURE TRANSITION IN MAGNETITE AND THE INTERNAL FIELDS ACTING ON IRON NUCLEI IN SOME SPINEL FERRITES, USING MÖSSBAUER ABSORPTION. R. Bauminger, S. G. Cohen, A. Marinov, S. Ofer, and E. Segal (Hebrew Univ., Jerusalem). Phys. Rev., 122: 1447-50(June 1, 1961).

A study is made of the internal fields acting on Fe^{57} nuclei in some spinel ferrites, with particular reference to the low-temperature order-disorder transition in magnetite, using the techniques of Mössbauer absorption. For the Fe^{3+} ions at both the octahedral and tetrahedral sites in nickel ferrite ($NiFe_2O_4$) at 300°K, γ Fe_2O_3 at 85 and 300°K, and magnetite (Fe_3O_4) at 85°K, the effective magnetic field at the Fe^{57} nuclei is the same and equal to about 5.1×10^5 gauss. In magnetite, the value of H_{eff} in the Fe^{2+} ions is about 4.5×10^5 gauss at 85°K. Measurements on Fe_3O_4 at room temperatures provide a microscopic confirmation of Verwey's hypothesis that above the transition temperature of magnetite there is a fast exchange between the ferrous and ferric ions in the octahedral sites. (auth)

19921 FLUORESCENT RESPONSE OF SCINTILLATION CRYSTALS TO HEAVY IONS. E. Newman, A. M. Smith, and F. E. Steigert (Yale Univ., New Haven). Phys. Rev., 122: 1520-4(June 1, 1961).

The light output of CsI(Tl) was measured as a function of energy for incident ions of B^{10}, B^{11}, C^{12}, N^{14}, O^{16}, and F^{19}. The response of NE 102 plastic and anthracene scintillators was also measured for ions of N^{14} and O^{16}, respectively. The response of CsI was essentially linear for energies above 6 Mev/nucleon. The NE 102 was linear for energies above 4 Mev/nucleon. The anthracene data showed slight curvature even at 9 Mev/nucleon. The response of CsI appeared to differ somewhat among crystal samples. (auth)

19922 A CONTRIBUTION TO THE SURFACE PROTECTION OF MOLYBDENUM AT HIGH TEMPERATURES. K. Sedlatschek and H.-J. Stadler (Metallwerk Plansee A. G., Reutte/Tirol, Austria). Planseeber. Pulvermet., 9: 39-43 (Apr. 1961). (In German)

A new silicide-coating for molybdenum is reported which prevents oxidation of the metal up to 1600°. In this process, the molybdenum is dipped into a copper–silicon melt, whereby a thick layer of molybdenumdisilicide is formed. The rate of growth of the layer follows the parabolic time-law and is determined by the diffusion of silicon from the melt to the metal. Special experimental findings of this process as well as aspects concerning possible technical application are included. (auth)

19923 OXIDATION PROTECTION OF COLUMBIUM ALLOYS THROUGH COATING BY PACK DIFFUSION TECHNIQUE. H. Blumenthal (Cromalloy Corp., West Nyack, N. Y.). Planseeber. Pulvermet., 9: 44-6(Apr. 1961). (In English)

The pack coating process can produce coatings on Nb and other refractory metals and their alloys, which have the desired oxidation resistance at high temperatures and at the same time preserve the ducility of the base materials. When some still existing problems will be solved for test pieces—not necessarily by the use of those pack compositions now under investigation—no difficulty is foreseen in applying this coating process to larger and more intricate structures. (auth)

19924 THE THERMAL EXPANSION OF HIGH-MELTING PHASES. H. Nowotny and E. Laube (Universität, Vienna). Planseeber. Pulvermet., 9: 54-9(Apr. 1961). (In German)

The thermal expansion coefficients of some transition metal carbides and silicides up to 1000°C were determined by x-ray means. The obtained values together with already known data are discussed in regard to the stability of these phases. (auth)

19925 INFORMATION ON THE SYSTEM URANIUM–ZIRCONIUM–(HAFNIUM, NIOBIUM, TANTALUM)–CARBON. F. Benesovsky and E. Rudy (Metallwerk Plansee A. G., Reutte/Tirol, Austria). Planseeber. Pulvermet., 9: 65-76(Apr. 1961). (In German)

Uranium monocarbide is a very promising fuel for graphite moderated high temperature reactors. At high temperatures, however, it reacts with graphite to form compounds richer in carbon. X-ray data of the systems UC–MeC–C (Me = Zr, Hf, Nb, Ta) show that in all these systems extended two-phase regions (U, Me) C + C occur. At 1700°C the stable B1-solid solution contains 30 mol.-% UC in the system UC–ZrC, 14 mol.-% UC in UC–HfC; 28 mol.-% in UC–NbC and 23 mol.-% in UC–TaC. At higher temperatures these boundaries shift slightly toward the UC side. The carbides U_2C_3 and UC_2 do not take up these metals into solution. Based on thermodynamical calculations together with the known values of UC, -17 ± 2.5 kcal was obtained for the free energy of formation of UC_2. The relatively large error results mainly from the uncertainty of the value for UC. (auth)

19926 ALLOYS OF TANTALUM DIBORIDE WITH IRON, COBALT, AND NICKEL. H. W. Lavendel (Lockheed Missiles and Space Div., Palo Alto, Calif.). Planseeber. Pulvermet., 9: 80-95(Apr. 1961). (In English)

Iron, cobalt, and nickel form with tantalum diboride similar quasibinary systems, with two intermediate compounds of the same composition, $MTaB_2$ and M_5TaB_2 (where "M" stands for Fe, Co, or Ni), and an M_5TaB_2/M eutectic containing 77.6 atom percent of the metal. The compounds are formed in the peritectic reactions TaB_2 + liquid = $MTaB_2$, and $MTaB_2$ + liquid = M_5TaB_2. In the case of iron and cobalt, at temperatures above 1400°C and at pressures up to 1 atmosphere, the $MTaB_2$ decomposes into TaB_2 + vapor. The temperature of the $NiTaB_2$ peritectic lies near 1500°C, all three M_5TaB_2 peritectics fall between 1170 and 1180°C, and all three eutectics between 1090 and 1130°C. The crystal structures of the cobalt and nickel compounds are isomorphous; the structures of the M_5TaB_2 compounds of cobalt and nickel are face centered cubic ($a_0 = 10.56_5$ A), the structures of the $MTaB_2$ compounds have not been identified. The crystal structures of $FeTaB_2$ and Fe_5TaB_2 are also unknown. (auth)

19927 SOME ASPECTS OF DISPERSION HARDENING IN THE URANIUM–URANIUM OXIDE SYSTEM. W. Arbiter and G. Stern (Nuclear Development Corp. of America, White Plains, N. Y.). Planseeber. Pulvermet., 9: 113-21 (Apr. 1961). (In English)

Dispersion hardening of uranium with finely divided UO_2 particles has been shown to produce a material with good hot indentation hardness, hot bend strength and resistance to deformation during α to β thermal cycling. It is reasonable to expect such a material to have good high temperature creep strength as well. Irradiation testing will permit a fuller evaluation of the ability of this material to undergo burnups of greater than 0.3% at temperatures in excess of 500°C (932°F), which is the present limitation on unalloyed wrought uranium. (auth)

19928 BINARY COMPOUNDS IN THE SYSTEMS BETWEEN ALKALINE-EARTH OXIDES AND URANIUM AND THORIUM DIOXIDES. Cesare Brisi (Politecnico, Turin). Ricerca sci., 30: 2376-81(Dec. 1960). (In Italian)

The possibility of binary compound formation in various alkaline-earth oxide/uranium dioxide and alkaline-earth oxide/thorium dioxide systems was examined. No stable compound was identified in the two systems CaO-ThO_2 and SrO-ThO_2. In the system SrO-UO_2 the formation of the compound $SrUO_3$, with a deformed perovskitic structure was shown. The true symmetry is probably orthorhombic: a = 6.03, b = 6.18, c = 8.62 A. In the systems BaO-UO_2 and BaO-ThO_2 the existence of the compounds $BaUO_3$ and $BaThO_3$ with a perovskitic structure was confirmed. (auth)

19929 FABRICATION OF ONE-INCH THICK, TEN-INCH DIAMETER WELDED INCONEL PIPE. W. L. Fleischmann (Knolls Atomic Power Lab., Schenectady, N. Y.) and R. F. Gurnea. Welding J. (N. Y.), 40: 620-8 (June 1961).

Mechanical and metallurgical data are given on specimens of Inconel plate and pipe after the various heating and forming operations involved in making of a fabricated pipe. The fabricated pipe meets the mechanical requirements of the Inconel plate Specification Sb-168 of the ASME Boiler and Pressure Vessel Code and the quality requirements of welded pipe stipulated in ASTM A358-56T specification for electric-fusion-welded austenitic chromium-nickel alloy steel pipe for high temperature service. The particular plate discussed was sensitive to the welding process used. Welding with coated electrodes and the tungsten-arc process produced sound welds while the heat-affected zone of the welds made by the gas-shielded-arc consumable-electrode process showed fissures. These fissures are associated with segregate regions in the base metal. (auth)

19930 INTERNAL STRESSES IN URANIUM METAL FROM FAULTY MACHINING AND BORING. Hans Bühler and Walter Schreiber. Z. Metallk., 52: 270-5(Apr. 1961). (In German).

Uranium test samples containing 0.35 wt.% Nb, which were 32 mm in diameter and 100 mm in length were used to show how internal stresses may occur through faulty boring, making the samples less useful for later appliance. In the as-received condition the test samples were without internal stresses. A center drilling of 5 mm in diameter was made by using a higher cutting speed and feed than normal. Internal stress measurements showed that a faulty boring leads to a state of internal stresses which results in tensile stress values of about 40 kg/mm^2 in the bore hole walls. It is shown that these states of internal stresses are mainly due to plastic deformation during faulty boring. They cannot be removed by a second cutting as the deformed layers cover a considerable portion of the diameter. Depending on the kind of internal stress states they can even be increased by a following cutting. (auth)

19931 X-RAY STUDY OF THE STRUCTURAL CHANGES IN STEEL ON ELECTROLYTIC SATURATION WITH HYDROGEN. V. V. Kuznetsov and B. N. Varskoi (Perm State Univ., [USSR]). Zhur. Fiz. Khim., 35: 595-9(Mar. 1961). (In Russian)

It is found that second order stresses and third order distortions in annealed specimens of Armco-iron, steel 10, and steel 50 regularly increase after cathodic polarization in sulfuric acid. Third order distortions are due to the formation of a solid solution between hydrogen and the metal; second order stresses are explained by the evolution of molecular hydrogen in the micropores. Determination of the intensity and width of diffraction lines may be used as a fruitful method in studying structural changes in metals taking place as the result of hydrogen sorption. (auth)

19932 THE RATE OF HYDROGEN DIFFUSION IN 1 × 18H9T STEEL AT HIGH TEMPERATURES AND PRESSURES. Yu. I. Archakov, I. D. Grebeshkova, and V. P. Teodorovich (All-Union Scientific-Research Inst. of Petroleum Chemical Processes, [USSR]). Zhur. Priklad. Khim., 34: 821-5(Apr. 1961). (In Russian)

The numerical values of hydrogen diffusion through various steels were determined at high pressures and temperatures to 1000°. The exponential relation between the diffusion rate and temperature at high pressures was verified, and the temperature coefficient for 1 × 18H9T steel was found to be 21650 cal/g-at. The developed method is expedient for determining the rate of gas diffusion into metals at high pressures and temperatures. (R.V.J.)

19933 A PRECISE DETERMINATION OF THE ATOMIC POSITION PARAMETER FOR α-URANIUM. Edward F. Sturcken (E. I. du Pont de Nemours & Co., Aiken, S. C.). and Ben Post. p.85-92 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

The new value determined for the parameter was y = 0.1025 ± 0.0003. The absorption errors and preferred orientation effects were eliminated and statistical precision of the measurements was increased by employing a single-crystal diffractometric technique. The cell dimensions were also refined by using the diffractometric technique for high-purity annealed polycrystalline U. Cell dimensions were a_0 = 2.854 A, b_0 = 5.869 A, and c_0 = 4.955 A, all ±0.002 A. Interatomic distances of the twelve nearest neighbors were two atoms at 2.754 and 2.854 A and four atoms at 3.263 and 3.342 A. The bond lengths were only slightly affected by the changes in y. The main effects of the new parameter are to alter the component of the bond along the b direction by 0.015 A and to change appreciably the calculated relative diffraction intensities. (auth)

19934 DETERMINATION OF THE MECHANICAL AND TECHNOLOGICAL PROPERTIES OF METALS. B. M. Gliner. Translated from the Russian 2nd edition. E. Bishop, translation editor. New York, Pergamon Press, 1960. 165p. $8.50.

This book is an authoritative source for the quantitative interpretation of mechanical test data found in Soviet literature. Testing methods are described according to a uniform plan: a definition is given of the characteristics to be determined, expressions from which the basic strength properties are to be calculated are given, the form and dimensions of the test pieces are noted, and a description is given of the test procedure to be used. Diagrams of the test instruments and equipment are included. Methods are given for determing the mechanical and technological properties at normal and elevated temperatures, including methods of determining such properties on welded joints and welded metals. (N.W.R.)

19935 MANUFACTURE OF FUEL ELEMENTS FOR ALL TYPES OF REACTORS. (to DEGUSSA). Belgian Patent 575,381. Priority date, Feb. 4, 1958.

Tubes made of high-melting-temperature metals such as Zr, Nb, Ta, Mo, Ni, Fe, or their alloys, are filled with powders of the same metals, their silicides or carbides, which are then covered with Pu or alloys of Pu. An efficient bonding of the materials to the tube is obtained by heating under very low pressure. (EURATOM)

19936 COATING A CYLINDRICAL CORE WITH A METAL OR ALLOY. M. Manet (to C.E.A.). Belgian Patent 581,092. Jan. 27, 1960.

Cylindrical fuel rods are canned by insertion into a cooled die fed with molten canning metal. The operation is continuous. The lower end of the fuel slug, which is the first to be clad, is solid enough to be held by a mechanical device when the upper end of the slug is released prior to passing through the die. (EURATOM)

19937 IMPROVEMENTS IN OR RELATING TO LEAD CASTINGS. Colin John Swanson (to National Smelting Co., Ltd.). British Patent 864,196. Mar. 29, 1961.

The addition of 0.60 to 1.01% by weight arsenic to sand-cast, chemically pure lead eliminates shrinkage porosity. It is also evident that as the arsenic content increases or decreases outside this range, the porosity increases. The amount of arsenic added to the lead is so small as to in no way affect the efficiency of the lead as radiation shields. The mechanical properties of a 1% arsenic–99% lead alloy and of pure lead are given. (N.W.R.)

19938 URANIUM–TITANIUM–NIOBIUM ALLOYS. Sherman Greenberg (to U. S. Atomic Energy Commission). U. S. Patent 2,990,274. June 27, 1961.

The patented alloy contains 3 wt.% Ti, 1.5 wt.% Nb, and 95.5 wt.% U. After quenching from 750 to 1000°C, the alloy is resistant to corrosion by water at 260°C.

Radiation Effects

19939 (D5-2245) EFFECTS OF FAST NEUTRONS ON CIRCUITRY EMPLOYING SEMICONDUCTOR DEVICES. R. G. Behrens (Boeing Airplane Co., Seattle). Nov. 5, 1957. Contract AF33(600)-35030. 66p. (AD-247715)

A study was conducted to determine the effects of radiation on selected airborne electronic equipment using transistors and crystal diodes. Results are given for amplifiers, oscillators, and components such as transistors, diodes, capacitors in exposures up to 10^{13} nvt. (J.R.D.)

19940 (HW-69256) THE EFFECT OF GAMMA RADIATION ON CLINOPTILOLITE. R. Fullerton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 25, 1961. Contract AT(45-1)-1350. 6p.

Clinoptilolite was found to possess the structural stability to irradiation which is characteristic of other silicates. No effect of gamma irradiation on the mineral was detected by x-ray diffraction, differential thermal analysis, or distribution coefficient determinations up to an exposure of 9.6 × 10^9 r (8.4 × 10^9 rad absorbed dose). (auth)

19941 (IBM-60-511-13) STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE). Report No. 1. Quarterly Progress Report No. 1, July 1, 1960–September 30, 1960. (International Business Machines Corp. Federal Systems Div., Owego, N. Y.). Contract DA 36-039 SC 85395. 20p.

Plans were made to subject memory core circuits to GODIVA's nuclear environment. Circuits were designed and data recording methods were defined and prepared for use during the test series. No data are now available and this report is essentially a summary of the plans and experimental procedures which will be carried out during the testing. (auth)

19942 (IBM-61-521-1) STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE). Report No. 2. Quarterly Progress Report No. 2, October 1, 1960–December 31, 1960. (International Business Machines Corp., Owego N. Y.). Contract DA 36-039 SC 85395.

Various current pulse-type tests were conducted on ferrite memory cores while these cores were exposed to pulses of nuclear radiation from a GODIVA assembly. In all tests, except a Disturb Test, no radiation effects were detected. The Disturb test results were inconsistent; therefore additional measurements are needed to determine if irradiation effects disturb the sensitivity of memory cores. Static tests showed that information stored in memory cores and on magnetic tape was not affected by GODIVA radiation. (auth)

19943 (IDO-16611) EFFECTS OF GAMMA RADIATION ON REACTIVITY MEASUREMENTS IN THE REACTIVITY MEASUREMENT FACILITY. D. G. Proctor and G. K. Wachs (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 28, 1961. Contract AT(10-1)-205. 37p.

The effect of gamma radiation from radioactive samples measured in the RMF was studied. No detectable effect due to photoneutrons was found when irradiated fuel samples were used as samples. Also no measurable reactivity effect was found when decaying gamma-ray source was used as a test sample. A method of estimating the reactivity error due to a decaying gamma-ray source is described. A comparison between geometrically-compensated and electrically-compensated ion chambers was made which shows that the electrically-compensated ion chamber is better suited for use in the RMF. (auth)

19944 (LMSD-288123) EFFECTS OF GAMMA RADIATION ON A TRANSISTOR RC PHASE-SHIFT OSCILLATOR. Virgil W. Moore, Jr., Walter M. Locke, and William W. Happ (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1960. 57p.

An investigation was conducted of a transistor RC phase-shift oscillator in operation in a 1000-curie Co^{60} gamma-ray environment. A total of seven identical oscillator circuits were irradiated producing changes in the transistor hybrid parameters, in circuit output voltage, and in frequency as a function of dosage. Failure analysis graphs show the prabability of derated frequency and derated output voltage for the circuit, and derated current gain for the transistor. (auth)

19945 (NAA-SR-1025(Del.)) ROLE OF IONIZATION IN RADIATION ANNEALING. J. D. McClelland, A. W. Smith, and E. J. Senkovits (North American Aviation, Inc., Downey, Calif.). Oct. 1, 1954. Decl. with deletions Mar. 3, 1960. Contract AT-11-1-GEN-8. 11p.

The role of ionization in the phenomenon of radiation annealing of graphite was studied by using a 1-Mev electron beam. Changes in the c-axis of a sample with a Hanford irradiation of 460 mwd/ct were studied. Two thermal anneals of 4 hours each at 350°C proved sufficient to complete the thermal annealing at this temperature. The samples were then irradiated for 7½ hours at a temperature of 340°C. The samples received an irradiation of 47 microampere-hours, equivalent in ionization to an exposure of 200 mwd/ct in a Hanford reactor. No changes were noted as a result of the electron bombardment. It is concluded that the ionization is not of major importance in radiation annealing. (auth)

19946 (NP-10181) DEVELOPMENT AND EVALUATION OF ELECTRON TUBE GLASSES RESISTANT TO RADIATION DAMAGE. Final Report, May 1, 1959 to September 30, 1960. R. Spencer (Chatham Electronics. Div. of Tung-Sol Electric Co., Livingston, N. J.). Contract DA-36-039-SC-78312. 40p.

Dummy bulbs of Corning 0080, 0120, 7720, 7052, 1723, and 1715 glass, and dummy bulbs of Owens-Illinois 51-26 (boron-free), 3% and 6% B_2O_3 glass were exposed to various integrated thermal neutron fluxes of from 0.367×10^{16} to 5.77×10^{18} nvt. Regular borosilicate hard glasses such as 7720 and 7052 were found to suffer the greatest physical damage, while the special boron free hard glasses such as Kimble EE-2 (51-26) and Corning 1715 glass along with such soft glasses as 0080 were found to suffer the least damage from thermal neutron bombardment. Ionization gauges enclosed in 7720 and 1723 glass show an increase in gas pressure from 10^{-6} mm before irradiation, to 5×10^{-3} and 3.7×10^{-3} mm respectively after exposure to 0.367×10^{16} nvt. Ionization gauges enclosed in 0080 glass show no increase in gas pressure after exposure to 4.0×10^{16} nvt. Tubes of type 5R4WGA were enclosed in both 7720 and 1723 glass. Generally it was found that the plate current rose to a greater extent in the 7720 type glass enclosures in comparison to the 1723 glass after exposure to 4.0×10^{16} nvt. Two tubes of type 6080WA enclosed in 0080 glass and two tubes of type 6080WB enclosed in 7720 glass were exposed to 2.2×10^{16} nvt. Both 6080WA's remained in specification after irradiation, while one 6080WB was fractured and the other had high grid current. All exposure levels were monitored by cadmium aluminum dosimeters. (auth)

19947 (NP-10193) EFFECT OF VACUUM AND ULTRAVIOLET RADIATION ON POLYMERIC MATERIALS. An Annotated Bibliography. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Apr. 1961. 29p. (SB-61-20)

An annotated bibliography of 60 selected references on polymeric materials that were investigated under the space conditions of vacuum and ultraviolet radiation is presented. The references selected cover the years 1948 to 1961. (M.C.G.)

19948 (SCTM-62-61(14)) A STUDY OF PULSE VOLTAGES DEVELOPED BY COAXIAL CABLES DURING PULSED NEUTRON IRRADIATION. James M. Caller (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 27p.

Coaxial cables are found to develop substantial voltage pulses when subjected to bursts of nuclear radiation. Various types of coaxial cable are tested in an effort to isolate the parameters affecting the amplitude and polarity of these voltages. The data indicate that the dielectric form and geometry of the cable, rather than its electrical properties are the principal governing factors. It is also shown that successively lower voltage pulses are produced by repeated nuclear bursts and that such changes are permanent and irreversible. An hypothesis explaining the phenomena involved is included, together with a suggested approach to the development of pulse-free cables. (auth)

19949 (TID-7602(Pt.I)(p.12-16)) IRRADIATION TESTING OF BERYLLIUM OXIDE–URANIUM DIOXIDE BODIES AT BATTELLE. John E. Gates (Battelle Memorial Inst., Columbus, Ohio).

Two irradiation experiments were carried out on cold-pressed, sintered beryllium oxide–uranium oxide pellets at 1450 to 1725°F until burnups of 1.5 to 2.0 at.% were achieved. The pellets for one experiment were 59 wt.% fully enriched UO_2 in BeO (86.4% theoretical density) clad with type 316 stainless steel, while in the other experiment the pellets were 56 wt.% UO_2 in BeO (98% theoretical density) clad with Hastelloy X. Comparative pre- and post-irradiation examinations of the pellets showed no visible deterioration or swelling, and the density decreased by only 1.0 to 2.4%. After postirradiation heating at 2400°F for 4 hr in He flow, a pellet showed only a slight surface discoloration. (D.L.C.)

19950 (TID-7602(Pt.I)(p.17-26)) THE IRRADIATION TESTING OF BERYLLIUM OXIDE–URANIUM DIOXIDE FUEL PELLETS BY GENERAL ATOMIC. Dale E. Johnson and J. Martin Tobin (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Criteria for selecting the particle size for the fuel dispersion and the volume fraction occupied by the fuel are given. UO_2–BeO pellets were irradiated to burnups of 38,000 to 46,000 Mwd/t U and pre- and postirradiation comparisons made of the dimensions and density. No significant change in the dimensions was observed, and there was no evidence of grain destruction or gas bubble or void formation. However, crushing tests indicate that the pellet compressive strength may have been decreased by as much as 33% by the irradiation. It is pointed out that ceramic materials present a problem due to density variations. (D.L.C.)

19951 HIGH-ALLOY STEEL IN NUCLEAR ENERGY PLANTS. [PART] I. J. Jägersberger (Gebr. Böhler & Co., A. G., Duesseldorf). Atomwirtschaft, 6: 154-7(Mar. 1961). (In German)

The radiation effects on high-alloy steel used in nuclear energy plants are reviewed. Neutron activation of the constituents of the steel are first considered, and the behavior of various alloying elements under irradiation by thermal neutrons is tabulated. The effect of neutron irradiation is then reviewed with a discussion of the strength properties of steels. (J.S.R.)

19952 THE KINETICS OF OPTICAL BLEACHING OF F-CENTRES IN γ-COLOURED KCl CRYSTALS. J. Z. Damm (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci., Sér. sci. chim., 9: 91-6(1961). (In English)

Optical density decay curves of F centers during optical bleaching are shown along with the equations necessary to prove their validity. It is shown that the concentration of color centers is uniform throughout the crystal and the observed changes are attributed to changes in thickness. (N.W.R.)

19953 EFFECTS OF COBALT-60 GAMMA RADIATION ON POLY(VINYL ALCOHOL). III. EFFECTS OF GAMMA RADIATION ON WATER-SWOLLEN FILMS AND AQUEOUS SOLUTIONS. Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 99-111(Mar. 1961).

Studies were done on the effects of gamma irradiation both in air and in vacuo on aqueous solutions and water-swollen films of polyvinylalcohol (PVA). The radiation-induced changes were followed by the measurements of viscosity, sol fraction, and degree of swelling. For the water-swollen films, remarkable differences were observed between the irradiation in vacuo and in air, but for the aqueous solutions of higher concentrations there were little difference. For the irradiation of water-swollen films in air the indirect effect of water is quantitatively discussed. It was found by a calculation that only 69% of the energy absorbed by water was used for the main chain fracture and that the energy dissipated per main chain fracture was about 36 ev. When aqueous solutions were irradiated, viscosities were increased with dose and finally a gel was formed in a manner similar to that observed in the case of vacuum-irradiation of water-swollen films. The ratio of the number of fractures and crosslinked units, p_0/q_0, was increased with the weight fraction of the polymer; the value of p_0/q_0 was 0.27, 0.39, and 0.55 at the weight fraction of 0.10, 0.20, and 0.25 respectively. The results obtained by the irradiation of the solutions containing 0.1 wt fraction of polymer which had stood for some period before irradiation showed that the sol fraction was decreased with standing time. (auth)

19954 GAMMA IRRADIATION EFFECT ON QUARTZ. I. A MINERALOGICAL AND GEOLOGICAL APPLICATION. Ichikazu Hayase (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 133-7(Mar. 1961).

Gamma radiation was applied to natural and synthetic quartz. The different geological occurrences were clearly detectable by the wide range of smokiness. When irradiated by gamma rays, the smokiness grade was the highest in volcanic quartz, intermediate in granite, and the lowest either in schist quartz or in low temperature quartz of hydrothermal origin. After a heating test at about 1000°C for 30 minutes, a marked increase in the smokiness grade was seen. Thus smokiness grade seems to indicate the crystallization temperature of that quartz. The significance of this relation between smokiness and crystallization temperature appears to have escaped the considerations of geologists and mineralogists. The gamma irradiation method should be applied to the study of granite petrogenesis and ore deposits. (auth)

19955 OPTICAL PROPERTIES OF IRRADIATED LiF CRYSTALS IN THE EXTREME ULTRAVIOLET. Riso Kato (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 153-7(Mar. 1961).

Optical absorptions of LiF crystals irradiated with γ rays or Van de Graaff electrons were investigated in the extreme ultraviolet region. A new absorption band at 11.1 ev was found at the tail of the fundamental absorption band. The oscillator strength of the band is estimated to be about 0.25 on the assumption of one electron center. Behaviors of other absorptions observed in the process of light bleaching of F bands, are also described and discussions are given on the nature of the 222 mμ band. (auth)

19956 COLOR CENTERS IN Cu-DOPED NaCl AND KCl CRYSTALS. Kuniya Fukuda (Kyoto Univ.) and Toshiko Nakagawa. Bull. Inst. Chem. Research, Kyoto Univ., 39: 158-65(Mar. 1961).

Cu-doped NaCl and KCl crystals, when irradiated by γ rays from Co^{60} at room or dry ice temperature, showed optical absorption bands of color centers associated with neutral and divalent Cu. F-coloration was desensitized and V-type bands such as V_2 or V_3 were completely suppressed by the existence of Cu ions in these crystals. (auth)

19957 EFFECTS OF GAMMA-RAY IRRADIATION ON ROCHELLE SALT. Koichi Toyoda, Akira Kawabata, and Tetsuro Tanaka (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 39: 189-94(Mar. 1961).

The property changes of Rochelle salt irradiated with γ rays are studied. It was found that the ferroelectric region became narrower as a result of irradiation, disappearing after prolonged irradiation. The most striking changes ap-

pear in the ferroelectric hysteresis loop, i.e., the double loop pattern is revealed in the irradiated crystal. It was also found that the piezoelectricity is affected as a result of irradiation. (auth)

19958 MODIFICATIONS BY NEUTRON IRRADIATION OF THE DIELECTRIC LOSS OF BOROSILICATE GLASSES. Jean Paymal, Beatrix Savouret, and Klaus Leibrecht (Centre de Recherches de la Compagnie de Saint-Gobain, Paris and Laboratoire d'Electronique et Radioelectricite de la Sorbonne, [Paris]). Compt. rend., 252: 1939-41 (Mar. 27, 1961). (In French)

The thermal neutron irradiation of borosilicate glasses causes an increase of the dielectric loss which is of importance even for relatively weak doses for which other properties such as specific weight do not seem to be affected. (tr-auth)

19959 EFFECT OF NEUTRON IRRADIATION AT LOW TEMPERATURE ON THE ELECTRIC CONDUCTIVITY OF LITHIUM FLUORIDE. Monique Dubois, Pierre Berge, and Georges Blanc. Compt. rend., 252: 2096-8(Apr. 5, 1961). (In French)

The comparison of the effects of irradiation in a nuclear reactor on lithium fluoride at room temperature and at the temperature of liquid nitrogen permits the mechanism for the rearrangement of the primary faults formed to be defined. The inhibition of the generating role of the carriers of the bivalent impurities is also shown. (tr-auth)

19960 RADIATION-CHEMICAL ALTERATIONS OF THE PROPERTIES OF POLYVINYL CHLORIDE. L. Wuckel (Institut für angewandte Physik der Reinstoffe, Dresden). Isotopentechnik, 1: No. 4, 112-16(Mar. 1961). (In German)

By the alteration of the limiting viscosity and the solubility as well as by examining the UR-spectra, the separation of HCl, and the addition of bromine, the part played by air oxygen in radiation effects on polyvinyl chloride, was studied. To this purpose, radiations were provided in air, nitrogen, and in vacuum. To study the effect of the specific surface, the radiations were made in the form of films, powder, and solid and pressed cylinders. (auth)

19961 GAMMA IRRADIATION STUDIES OF SOME BORATE GLASSES. Adli Bishay (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 44: 289-96(June 1961).

The gamma-ray-induced optical absorption in a series of cabal (calcium-boron-aluminum) glasses was studied and is interpreted, wherever possible, in terms of structural concepts. A resolution of the observed absorption spectra showed that three Gaussian-shaped bands were induced with their maxima at about 2.3, 3.5, and 5.0 ev (550, 350, and 250 mμ). The 2.3-ev band decreased in intensity with increasing CaO content, reaching a minimum intensity at a composition corresponding to the four-coordination of about 20% of the boron. Further increase in CaO content was associated with an increase in the intensity of this band. The intensity of the 3.5-ev band decreased gradually with increased mole % of CaO and increased with increased Al_2O_3. The 5.0-ev band showed an abrupt increase in intensity which corresponded to the appearance of nonbridging oxygens in the network. Replacing Ca^{2+} by Mg^{2+}, Sr^{2+}, or Ba^{2+} or replacing Li^+ by Na^+ or K^+ showed that glasses containing large ions of low field strength give less induced absorption than glasses containing small ions of high field strength. A potassium alumina borate glass melted under reducing conditions gave a considerably higher uv transmission, before irradiation, as compared with the same glass melted under normal conditions. The gamma-induced absorption of these two glasses showed that reducing conditions resulted in a decrease in the intensity of the 2.3- and 3.5-ev bands, and an increase in the far-ultraviolet-induced absorption. The effect of additions of As, Tl, Ti, Ge, and some rare-earth oxides is discussed. (auth)

19962 VOLUME INCREASES IN FISSILE MATERIALS ON NEUTRON IRRADIATION. G. W. Greenwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inst. Metals, 89: 308-16(Apr. 1961).

Scientists from England, France, and the U. S. reviewed a previous work by Dr. Greenwood on this subject. A comparison is made between calculated and observed results on volume increases in irradiated uranium metal. Work done at Harwell in parallel to swelling studies is discussed. The aim was to understudy the behavior of the inert gas atom in metals and the early stages of swelling. The author replied to the discussion. (P.C.H.)

19963 IRRADIATION TECHNIQUES FOR FISSILE MATERIALS—6. O. S. Plail (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power, 6: No. 62, 81-2(June 1961).

Operational aspects of fissile material irradiation programs are discussed. Advantages of exposing scientific personnel to practical problems of experiments are enumerated. Design perfection of irradiation equipment is balanced against equipment simplicity, safety, and expense. Improvements in remote handling facilities and technical standards are described. (T.F.H.)

19964 FURTHER RESULTS OF IRRADIATION OF URANIUM CARBIDE. A. W. Hare (Battelle Memorial Inst., Columbus, Ohio), S. Alfant, F. A. Rough, and D. I. Sinizer. Nuclear Sci. and Eng., 10: 24-30(May 1961).

The results of postirradiation examinations on UC compounds having nominal compositions of 4.6, 4.8, and 5.0 wt.% C are given after irradiation to approximate burnups of from 1000 to 15,000 Mwd/t of U. Density changes are small, varying from a minimum of 0.7% to a maximum of about 2.5%. Cracking occurs in all specimens; however, it can probably be largely attributed to thermal stresses. Depletion of carbon occurs in the specimens having the nominal 5 wt.% C composition. Metallographic examination shows that these specimens appear to revert to the 4.8 wt.% C stoichiometric composition. The fission gas retention properties of this material appear quite good. In all cases, the amount of fission gas released is comparable to the calculated amount released by recoil. (auth)

19965 MECHANISM FOR PRODUCTION OF INTERSTITIALS IN KCl BY X RAYS AT LOW TEMPERATURES. R. E. Howard (National Bureau of Standards, Washington, D. C.), Seymour Vosko, and R. Smoluchowski. Phys. Rev., 122: 1406-8(June 1, 1961).

Experiments indicate that halogen vacancies and interstitials may be formed by x irradiation of KCl at low temperatures. The validity of a mechanism based on multiple ionization depends upon several factors; among these factors are efficiency of ionization and the availability of sufficient kinetic energy to remove the interstitial from the immediate vicinity of the vacancy. These two conditions are satisfied. (auth)

19966 RADIATION DAMAGE IN STEELS. D. Hull (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Indian Inst. Metals, 13: 151-61(June 1960).

The effect of irradiation on En2 mild steel is determined using tensile and impact tests. A method, based on Cottrell's theory of brittle fracture for estimating the increase in notched impact transition temperature ΔT with irradiation dose θ from tensile experiments, is described. The value

of the constant $\Delta T/\theta^{1/3}$ is calculated for four grain sizes of En2 steel. The estimated values of ΔT are in reasonable agreement with the experimental results from the notched impact tests. The value of this method of determining the sensitivity of steels to radiation embrittlement and the importance of grain size is emphasized. (auth)

19967 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE POLYMERISATION OF ETHYLENE. (to Houilleres du Bassin du Nord et du Pas de Calais). British Patent 868,304. May 17, 1961.

A process for the polymerization of ethylene in which the ethylene is fixed on a support which is previously submitted to ionizing irradiation, and in which the support consists of at least one paraffinic compound is described. The process is carried out at 0 to 300°C and at 40 to 600 kg/cm^2. (N.W.R.)

PHYSICS

General and Miscellaneous

19968 (AFCRL-183) INVESTIGATIONS OF RARE-EARTH OXIDE CATHODES. Final Report, May 1, 1959–March 31, 1961. J. B. Baker and G. B. Gaines (Battelle Memorial Inst., Columbus, Ohio). Contract AF19(604)-5691. 24p.

High thermionic-emission levels were obtained from gadolinium oxide and from a mixture of 75 Nd_2O_3–25 Gd_2O_3 but special activating procedures were required. The emission properties of the oxide mixtures differed for various refractory-metal bases with the highest emission currents being obtained with tantalum bases. The presence of carbon in the coating of a cathode composed of the 75 Nd_2O_3–25 Gd_2O_3 mixture resulted in higher activation than was obtained without the carbon. Gadolinium oxide gives higher emission than thorium oxide at 1200 to 1500°C. (auth)

19969 (HW-SA-2146) THE MEASUREMENT OF THE ELECTRON ENERGY REQUIRED TO PRODUCE AN ION PAIR IN VARIOUS GASES. Ira Thomas Myers (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1958. 99p.

Thesis submitted to State Coll. of Washington.

Measurements were made of the energy required to produce an ion pair in air. The results were: using Co^{60} gamma rays, 33.3 ± 0.8 ev/ip; using tritium beta particles, 35.2 ± 1.8 ev/ip. The increase of W(Air) with increasing energy predicted by Wang and Bethe was not found. Tables of previous work by other authors are included. A summary is given including a "best" value of the energy to produce an ion pair in 43 different gases, for electrons, alpha particles, and protons. (auth)

19970 (NASA-TN-D-845) COMPARATIVE MEASUREMENTS OF BEAM POWER IN ION-ROCKET RESEARCH. E. A. Richley, V. A. Sandborn, L. V. Baldwin, and E. E. Dangle (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1961. 32p.

Preliminary results obtained from three schemes for measuring high-current ion-beam powers in experimental ion-rocket engines are presented and discussed. Electrical meter values are compared with integrated values of ion-beam power obtained from two types of calorimeters. Agreement among the three methods of approximately ±5% was attained for cesium ion-beam powers over the range of 400 to 1000 watts. (auth)

19971 (NP-10138) QUARTERLY PROGRESS REPORT NO. 40 [ON SOLID STATE PHYSICS]. (Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group). Apr. 15, 1961. Contract Nonr-1841(34). 34p.

Discussions are presented of investigations of energy bands in nickel and calculations for NaCl structure carried out by the augmented plane wave method. Core functions and non-core energy bands were calculated for silicon, for which an exact Hartree-Fock core-core exchange was included. Preliminary results are given for magnetic hyperfine interaction studies in nitrogen. The contribution of spin or exchange polarization to the magnetic interaction of a rare earth ion with its neighbors and with its own conduction electrons was investigated for Gd^{3+} and Gd^{+} ions by Hartree-Fock calculations and for Gd^{3+} ions by spin-polarized H-F calculations. Considerations are given for theories of the origin of the F^{19} hyperfine structure in transition element fluorides using the diatomic system, $Mn^{2+}-F^{-}$. (B.O.G)

19972 (NP-10158) FIRST JOINT PROGRESS REPORT OF THE LABORATORIES FOR MOLECULAR SCIENCE AND MOLECULAR ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS. (Massachusetts Inst. of Tech., Cambridge). Jan. 1961. Contract Nonr-1841(10); et al. 219p.

A semi-annual report comprising descriptions of about fifty individual research efforts is presented. The majority of the work is done by graduate students. Investigations are included on paraelectrics and ferroelectrics, magnetic resonance spectroscopy, magnetic single crystals, conduction and breakdown, electric dipoles in liquids, materials for thermoelectrics, thermal conductivity, and computer components and system. Other research is reported on topology of crystal structures and electronics associated with thin film devices. (J.R.D.)

19973 (NP-10197) MOBILITY AND CLUSTERING OF NEGATIVE IONS AND MASS-SPECTROGRAPHIC STUDY OF ION-MOLECULE REACTIONS OCCURRING AT THERMAL ENERGIES UNDER GAS KINETIC CONDITIONS. Final Summary Report. Technical Status Report No. 23, August 1, 1955 to March 31, 1961. E. W. McDaniel and D. W. Martin (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AF18(600)-1524. 12p.

A summary of research on mobility and clustering of negative ions, ionization, and plasmas and of mass spectrographic studies of ion-molecule reactions is presented. Objectives, methods, and results are reviewed. A list of publications and reports is included. (M.C.G.)

19974 (NP-10271) NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. PROGRESS REPORT FOR THE PERIOD JANUARY–MARCH 1961. (Naval Research Lab., Washington, D. C.). Apr. 1, 1961. 49p.

The Naval Research Laboratory progress report for the period of January to March 1961 on nuclear physics consists of six articles. The articles are on elastic scattering of 6.7 Mev neutrons from silver indium, multichannel data on the NAREC, imaginary numbers in quantum mechanics, wave propagation, viscous instability in electron storage ring, and a solenoid-focused guide ring for the storage of an intense electron beam. (N.W.R.)

19975 (NP-10271(p.21-7)) SOME REMARKS ON WAVE PROPAGATION. D. C. dePackh (Naval Research Lab., Washington, D. C.).

Remarks are made on the application of the Sturrock's principle to the classification of waves based on criteria clearly separating the propagative and undulant excitations of a medium, and the suggestion is offered that the usual complex exponential decomposition cannot be used carelessly if one is to deal with real disturbances. Comparatively simple arguments are given for the requirements of an internal medium called upon to support traveling and standing waves. It is also shown that the real wavelength analysis has the advantage that all branches with w_i less than 0 represent physically growing waves, whether local or undulant. (N.W.R.)

19976 (OOR-1816:6) RADIOFREQUENCY RESONANCE REORIENTATION. Technical Report No. 17, January 1–December 31, 1960. F. G. Major (Washington. Univ., Seattle). Contract DA-04-200-ORD-620. 5p.

Atomic hydrogen magnetic resonance signals were obtained with a total background pressure not exceeding 10^{-4} mm Hg. At this pressure the atoms may diffuse across their container sufficiently rapidly that the advantages of performing the experiment "in the vacuum," namely the absence of perturbations by the residual molecules, and the motional averaging of the magnetic field, may be realized. (auth)

19977 (TID-7597(p.523-44)) THE ADSORPTION OF HYDROGEN AT GRAPHITE SURFACES. W. J. Thomas (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A study was made of the chemisorption of hydrogen at graphite surfaces and the effect of removing surface oxide. At −196°C the graphite sample adsorbed a volume of hydrogen which was measured as 0.145 ± 0.001 $cm^3 g^{-1}$. It was determined that the amount due to fast non-activated chemisorption was 0.005 ± 0.002 $cm^3 g^{-1}$. The effect of a preadsorbed film of oxygen was to inhibit completely any low temperature fast non-activated hydrogen chemisorption. At 450°C the graphite adsorbed hydrogen slowly. Above 600°C equilibrium adsorption was established after 2 to 3 hr. Studies showed this to be an activated chemisorption. (M.C.G.)

19978 (TID-7597(p.560-85)) STUDIES OF GAS EVOLUTION BY GRAPHITE. L. G. Overholser and J. P. Blakely (Oak Ridge National Lab., Tenn.).

Experimental studies designed to yield information on the quantity and composition of the gas evolved by different types of graphite at various temperatures were carried out. Weight losses were measured on most of the samples and found to range from 0.01 to 0.2% for samples heated in the induction furnace, and from 0.005 to 0.04% for samples heated in the external resistance furnace. Weight losses for the gas-purified graphites were generally less by about a factor of 10 than losses in reimpregnated, porous, and thermally purified graphites. Interval profiles for the volume and composition of gas evolved by typical thermally purified graphites are given. The total volume of gas evolved per unit volume of graphite showed no dependence on sample size over the relatively small range studied. (M.C.G.)

19979 (TID-11751) THERMOELECTRIC STABILITY OF Pt−Rh THERMOCOUPLES. Milestone No. 1 Report. Ralph J. Freeman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 2, 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 127p. (XDC-60-12-28)

Pt−Rh thermocouples were tested under continuous and temperature cycling conditions. Noble-metal-sheathed thermocouples were found to be mechanically reliable in the temperature range of 2500 to 2600°F for 542 hr and to withstand 1,315 thermal cycles with thermal shock times of 40 sec through the 2500 to 1000°F range. However, the thermoelectric stability of sheathed thermocouples was poor due to volatilization of Rh and Pt. One configuration (Duax) shows promise of maintaining the required stability. (D.L.C.)

19980 (TID-12563) SHOCK INITIATION OF EXPLOSIVES. III. LIQUID EXPLOSIVES. J. R. Travis, A. W. Campbell, W. C. Davis, and J. B. Ramsay (Los Alamos Scientific Lab., N. Mex.). [1961]. 19p.

The shock initiation of detonation in nitromethane was shown to be a thermal explosion. A shock wave entering nitromethane heats and compresses it. After a delay, a detonation starts at the interface where the explosive has been hot longest and proceeds through the compressed liquid at a velocity greater than the steady-state velocity in unperturbed nitromethane. This wave overtakes the shock wave and overdrives a detonation in the unshocked explosive. The velocities and pressures of these shock and detonation waves were measured. Evidence for chemical reaction occurring before the detonation in the shock-compressed explosive is presented for nitromethane and Dithekite 13. (auth)

19981 (TID-12793) REEMISSION OF IONICALLY PUMPED HELIUM BY HELIUM ION BOMBARDMENT. Scientific paper 403FF530-P1. J. H. Carmichael and P. M. Waters (Westinghouse Electric Corp. Research Labs., Pittsburgh). Feb. 7, 1961. 23p.

Measurements were made of the release of ionically pumped helium gas when the metal is bombarded with helium ions. The reemitted helium is distinguished from the bombarding helium by the use of a mass spectrometer and by using either He^3 as the bombarding atom and He^4 as the trapped atom, or vise versa. The data are presented as a function of the amount of gas initially trapped, the number of bombarding ions, the initial kinetic energy of the trapped atoms, and the kinetic energy of the bombarding ions. Comparison of these data with those obtained using kyrpton as the bombarding ion indicates the different behavior in these cases. A replacement mechanism is more consistent with the data where helium is the bombarding ion. The corresponding data using krypton were satisfactorily explained by sputtering of the metal target. (auth)

19982 (UCRL-6356) CALCULATION OF SPALL BASED ON A ONE-DIMENSIONAL MODEL. Mark L. Wilkins (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 30, 1961. Contract W-7405-eng-48. 14p.

The detonations of a high explosive in contact with a metal plate can cause the plate to spall or fracture. In order to quantitatively describe the phenomena, a one-dimensional model of the H. E. plate system was assumed. The problem was then analyzed in terms of the interactions of compression and rarefaction waves. Quantitative predictions of spall using the one-dimensional model were compared to experiment and the agreement was found to be good. (auth)

19983 (UCRL-9388) THERMAL PROPERTIES OF SOLID HYDROGEN UNDER PRESSURE (thesis). William Herbert Orttung (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1, 1961. Contract W-7405-eng-48. 163p.

A calorimeter was designed and constructed for use in the temperature interval 1 to 25°K with samples of solid hydrogen under pressures up to 12,000 kg/cm^2. Unusual features of the calorimeter include the use of two baths for liquid hydrogen or helium, a jaw-type thermal contact capable of high contact pressure, and a set of flanges at the cell level for ready access. The associated high-pressure-generating apparatus was also designed and constructed. Pressures were generated with oil pumps and an intensifier. The oil was separated from the hydrogen by steel U-tubes half full of mercury, three of which were required for different pressure ranges. The highest-pressure U-tube was isolated from the rest of the system by mercury frozen in a steel capillary. The hydrogen entered the calorimeter through high-pressure capillary tubing, in which it was then frozen to isolate the sample in the cell. Catalyst chambers were constructed for the conversion of normal hydrogen to para hydrogen, and a three-stage system uti-

lizing alumina catalyst at liquid-hydrogen temperature was constructed for the separation of ortho hydrogen from para hydrogen. Because the calorimeter was of unconventional design, various modifications and procedures had to be worked out. A dummy cell was used for these developments. The high-pressure apparatus was tested to 6000 kg/cm^2 with hydrogen at room temperature. Satisfactory high-pressure seals for the low-temperature cell were not developed soon enough to enable data to be taken. The theory of the anomalous heat capacity for low concentrations of ortho hydrogen or para deuterium was extended by a calculation based on the angular potential energy between adjacent molecules. At 1 atm it was found that only electrostatic quadrupole-quadrupole interactions had to be considered, but at higher pressures, the valence forces became important. The case of three ortho molecules in a row was also treated in the quadrupole approximation. The heat capacity predicted by this model is somewhat different from that predicted for isolated ortho-ortho pairs. The theory was compared with the available 1-atm data, taking into consideration the relation between the total ortho concentration and the relative amounts of isolated ortho molecules, isolated pairs of ortho molecules, and more complicated configurations. The suggestion of T. Nakamura that an additional term in the anomalous heat capacity proportional to the ortho concentration is needed to explain the data seems to be supported by the analysis, although comparison with a larger amount of data would be desirable. (auth)

19984 (AEC-tr-3971) ADVANCES IN PHYSICAL SCIENCES. Translation of Uspekhi Fizicheskikh Nauk, Volume 61, Nos. 1-4. Jan.-Apr. 1957. 631p. (PST-Cat.-110).

A translation of 19 papers in this journal is presented. Separate abstracts were prepared for 13 of the papers. (M.C.G.)

19985 (AEC-tr-4600) DURATION OF THE EXCITED STATE OF MOLECULES AND PROPERTIES OF FLUORESCENT SOLUTIONS. M. D. Galanin. Translated by Lydia Venters (Argonne National Lab.) from Trudy Fiz. Inst. Akad. Nauk S.S.S.R., Fiz. Inst. im. P. N. Lebedeva, 5: 339-86(1950). 59p.

Solutions of brightly fluorescent dyestuffs were used to investigate the processes that occur in excited molecules. Lifetime, relative yield, and degree of polarization measurements were made. The process of resonance migration of the migration energy which leads to depolarization of the fluorescence when the concentration of the solution is increased and some quenching processes of the fluorescence dependent on the deactivation of the excited molecules are discussed. Methods of measuring the duration of fluorescence, concentration depolarization of fluorescence, theoretical evaluation of the probability of resonance energy transfer, concentration depolarization in quenching, effects of secondary fluorescence, effects of overlapping of the absorption and fluorescence spectra on the concentration depolarization, quenching by foreign substances and concentration quenching, temperature quenching, and quenching of dyestuffs with "nonrigid" skeleton are described. (M.C.G.)

19986 (AEC-tr-4621) THERMIONIC CONVERSION OF THERMAL ENERGY TO ELECTRICAL ENERGY BY THE USE OF THORIUM CARBIDE. N. D. Morgulis and Yu. P. Korchevoi. Translated from At. Energ. (U.S.S.R.), 9: 49-51(1960). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 22048.

19987 (CEA-tr-R-1229) DETERMINATION DU POIDS PAR LA METHODE D'ABSORPTION DU RAYONNEMET-β (COURBES D'ERREURS). (Determination of Weight by the Method of Absorption of β Radiation (Curves of Errors)). V. S. (C.) Merkulov. Translated into French from Izmeritel'naya Tekh., No. 4, 43-5(1958). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 4860.

19988 (NP-tr-603) DEVELOPMENT AT LOW TEMPERATURE. J. Fournaux (Brussels. Centre d'Étude de l'Énergie Nucléaire). Translated by S. Pease (U.K.A.E.A., Atomic Energy Research Establishment) from Report BLG-42, p.1-8, Jan. 7, 1960. 12p. (Handwritten MS.)

Development of thick nuclear emulsions without distortions is reported by use of Amidol developer at 0°C. The best fog-particle discrimination was obtained with 10 hours development in Amidol with a small amount of KBr. (J.R.D.)

19989 (UCRL-Trans-470(L)) ON THE DISTRIBUTION OF ELECTRON ENERGIES FROM ANTIMONY-CESIUM CATHODES. A. I. Pyatnitskii. Translated by Esther Goldberg from Radiotekh. i Elektron., 2: 714-26(1957). 25p.

By using interchangeable cathodes in a spherical condenser, measurements were made of photocurrent and secondary emissions from an Sb–Cs cathode and an Ag–Cs layer. The results of the measurements showed an essential difference in the voltampere path properties of the photocurrent for the Sb–Cs cathode and Ag–Cs layer, which confirmed the presence in the Sb–Cs cathode of secondary electrons with insufficient energy and indicated the great dependence of the number of these electrons on the quantity of cesium in the cathode. On the basis of the results of these measurements, the energy scheme of an Sb–Cs cathode was considered. (auth)

19990 THE ENVELOPE OF GLOW DISCHARGE ARCS ON EASILY EVAPORATED CATHODES. Rudolf Arndt (Institut für Gasentladungsphysik, Deutsche Akademie der Wissenschaften, Greifswald, Ger.). Ann. Physik, (7) 7: 159-78(1961). (In German)

The transition of normal N_2 high pressure glow discharges on Cu, Ag, Ni, and Au cathodes and abnormal He low pressure discharges on Hg cathodes to the arc was compared with the physical-chemical properties of the cathode metal. Cu_2O particles in Cu, the hydrogen poisoning in Cu and Ag, non-homogeneous oxide layers on Cu, Ni, and Hg, and isolated particles from glass can induce the transition. They are also induced by the mere presence or explosion of particles from Hg–N_2 compounds onto Hg. Homogeneous oxide layers and the hydrogen burden of Ni and Hg cathodes do not promote arc formation. From the conic formation on Ag, the stability of Hg–N_2 compounds, and some investigation with glass threads on Hg it was concluded that the microscopic field distortion through discharge of the smallest isolated particles on the cathode can induce transitions in the arc. (tr-auth)

19991 EXTINGUISHMENT OF CRYSTAL PHOSPHORS WITH ULTRASONICS AFTER IRRADIATION WITH UV LIGHT AND β PARTICLES. Klaus Friedrich (Institut für angewandte Radioaktivität, Leipzig). Ann. Physik, (7) 7: 201-8(1961). (In German)

Luminescent screens of ZnS(Cu) and R 28 (activated $2BaBr_2 \cdot BaF_2$) were extinguished after irradiation by means of ultrasonics. The luminescence occurring during the sonic irradiation was measured with a secondary electron amplifier and registered with a compensation recorder. The dependence of the extinguishable light on the experi-

mental conditions was determined. For the case of continuous irradiation with uv light, equations were derived which represented the relationship between the luminescent light and the irradiation time and intensity. For excitation with β particles a relationship between the illumination occurring in the irradiation and the irradiation time was determined. (tr-auth)

19992 EXPERIMENTS ON THE POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD. F. C. Hoh. Arkiv Fysik, 18: 433-41(1961). (In English)

The abnormal diffusion of the positive column in a longitudinal magnetic field observed by Lehnert is investigated with a new apparatus and with improved techniques. The measurements confirm earlier results and extend these to a wider range of pressures, discharge currents, magnetic fields, and to different gases. The experimental method is checked by a number of tests. The noise in the discharge current and the ion current to electric probes inserted in the plasma indicate a transition of the state of the discharge and an enhancement of the diffusion rate. This occurs near the critical magnetic field observed in earlier measurements on the potential gradient. Some features of the abnormal diffusion phenomenon are discussed on the basis of observations. (auth)

19993 EXPANSIONS OF WAVE FUNCTIONS IN TERMS OF BESSEL FUNCTIONS. Per O. M. Olsson (Univ. of Stockholm). Arkiv Fysik, 19: 17-20(1961). (In English)

Certain solutions of wave equations are expanded in a series containing an arbitrary parameter. Depending on the choice of the parameter, different expansions in terms of Bessel functions and special cases thereof are obtained. The general expansion coefficient and a recurrence relation for their calculation is given. The expansions can be used to study the asymptotic behavior of transition matrix elements of quantum mechanics. (auth)

19994 ON THE CALCULATION OF IONIZATION RATE IN WEAKLY IONIZED GAS IN THE PRESENCE OF AN ELECTRIC FIELD. Jacques Papet-Lépine. Arkiv Fysik, 19: 33-46(1961). (In French)

If inelastic collisions are infinitely small in comparison to number of elastic collisions, the rate of ionization may be calculated if the various probabilities permitting the passage of the molecule from one state to another are known. Three areas of utilization are defined according to the difference between the temperature of the gas electrons and the gas molecules. The difference is a function of the electric field over a unit of pressure. The rate of ionization is connected to basic knowledge of electric fields in order to utilize different cases in practice. (tr-auth)

19995 X-RAY FLASH SPECTRA OF Fe, Ni AND Cu. Per Olof Schörling. Arkiv Fysik, 19: 47-67(1961). (In English)

K-spectra of Fe, Ni and Cu from an x-ray flash tube with low inductance were recorded photographically and compared with spectra from an ordinary x-ray tube. In the flash spectrum the satellite $K\beta'$ was much stronger, the $K\alpha_1$ line was broadened on both sides, the $K\alpha_2$ line on the low energy side, and the $K\beta_{1,3}$ line on the high energy side. The probable cause of these effects is multiple ionization by successive collisions with incident cathode electrons. The results support Parratt's explanation of the origin of $K\beta'$ and the asymmetry of $K\alpha_1$ amd $K\alpha_2$. An alternative theory by Kakuschadse is rejected. (auth)

19996 THE EFFECTS OF DISSIPATION IN THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES. John Carstoiu. Compt. rend., 252: 2070-2(Apr. 5, 1961). (In French)

The effects of dissipation in the propagation of magnetohydrodynamic waves are governed by partial derivative equations of higher order than the second and of a mixed hyperbolic-parabolic mixed type. These equations are briefly formulated in their physical aspect. (J.S.R.)

19997 CATHODIC PULVERIZATION OF METALLIC TARGETS BY IONS OF AVERAGE ENERGY (10-100 KEV). Nicole Colombie. Compt. rend., 252: 2108-10(Apr. 5, 1961). (In French)

A brief description is given of the experimental arrangement used. The results on the rapidity of pulverization of copper and silver by argon ions with energy from 10 to 100 kev are reported. (tr-auth)

19998 THE LUMINESCENT EMISSION OF CADMIUM SULFIDE BOMBARDED BY CATHODE RAYS. François Bombré and François Gans (L.I.R.T.A., Gif-sur-Yvette, [France]). Compt. rend., 252: 2209-11(Apr. 10, 1961). (In French)

When cadmium sulfide is bombarded by electrons, in addition to the well-known red radiation, an emission of green light of still badly defined origin was observed. The green flux thus emittted depends on the purity of the substance, on the density, and on the acceleration voltage of the bombardment point. The position, in the spectrum, of this green emission varies with the density of the current. (tr-auth)

19999 EFFECT OF OXYGEN ON LIQUID SCINTILLATORS. EFFECT OF TEMPERATURE. Gilbert Laustriat and André Coche (Centre de Recherches Nucleaires, Strasbourg). Compt. rend., 252: 2217-19(Apr. 10, 1961). (In French)

The effect of oxygen on the yield of liquid scintillators depends on the temperature, but it is not influenced by the presence of antioxygens. An examination of the inhibiting effect on the transfer of energy from the primary solution to the secondary solution seems to indicate that different modes of transfer are possible, according to the concentration of the second solution. (tr-auth)

20000 THE BEHAVIOR OF TUBES WITH IONIZED RARE GAS DURING THE PASSAGE OF A BRIEF PULSE. Robert Desbrandes, Guy Norel, and Yves Morineau (Institut Français du Pétrole, Rueil-Malmaison, [France]). Compt. rend., 252: 2393-5(Apr. 17, 1961). (In French)

A supplementary conductivity was observed in plasma consecutive to the passage of a brief pulse from an electrode placed in a tube of ionized rare gas. This conductivity is shown by an indentation whose duration is a direct function of the crest height of the exciting pulses. An indentation of several milliseconds can be attained. (tr-auth)

20001 CALIBRATION OF A NEUTRON SOURCE. Dilşad Talibhan Elbrus (Univ., Istanbul). Istanbul Univ., Fen-Fak. Mecmuasi, Seri C, 25: No. 1-2, 40-6(Jan.-Apr. 1960). (In German)

A Ra-Be neutron source consisting of 80 mg Ra and 480 mg Be was submerged in a water column of 63.5-cm diameter and 87.8 cm high, and the distribution of Cd neutrons was measured as a function of position using the photographic method. Gold foil of 0.0105-mm thickness was used as activation material. The true specific activity of the foil, activated at 10 cm from the source, was determined with G-M counters. It was found that the source emitted 6900 neutrons/sec/mg. In addition, the photographic method was used to determine the fraction of the

activity due to resonance neutrons. This amounted to 20%. (tr-auth)

20002 SOLID ANGLE CALCULATIONS. G. Rowlands (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 10: 86-93 (Apr. 1961). (In English)

An analogy between the calculation of the total solid angle subtended by an aperture at a point or extended source and the calculation of certain electrostatic forces and energies is discussed. It is shown that such solid angle calculations reduce to the evaluation of the electrostatic energies of uniformly charged surfaces. A collection of formulae for the calculation of the electrostatic energy of uniformly charged surfaces for a range of different shapes is given. The general method is illustrated by considering the solid angle subtended by circular and rectangular apertures at point, surface and volume sources. In the case of rectangular apertures and for a range of source distributions, the value of the solid angle may be expressed analytically in closed form. (auth)

20003 PROPAGATION OF ELECTROMAGNETIC WAVES IN A MODIFIED SPIRAL WITH CROSS-WOUND COILS PLACED IN CYLINDRICAL WAVE GUIDE. S. S. Kalmykova, S. S. Tret'yakova, and V. P. Shestopalov (Khar'kov State Univ., USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Energet. i Avtomat., No. 2, 159-64(Mar-Apr. 1961). (In Russian)

A screen waveguide amplifies the delaying properties of a system, reduces dispersion, and increases the band width. A spiral with a screen reduces the grouping of delayed electromagnetic waves. The impedance of screened spiral harmonics is increased in comparison to open spiral. The relation between the impedance of zero and higher harmonics deteriorates as the screen is approached and the frequency is increased. (R.V.J.)

20004 AN ITERATION-VARIATION METHOD FOR WAVE PROPAGATION PROBLEMS. W. J. Byatt and G. P. DeVault (Sandia Lab., Albuquerque, N. Mex.). J. Geophys. Research, 66: 1793-7(June 1961).

In a medium in which the index of refraction varies in one space coordinate only, transform methods are convenient for reducing an inhomogeneous scalar wave equation to an ordinary differential equation in which the square of the space-dependent index of refraction appears explicitly. An iteration-variation method of obtaining approximate expressions for the dispersion relations within the medium is discussed. The ordinary differential equation is converted to an integral equation, the solution of which is begun by interation. The individual terms in the series thereby formed, which we shall call iterates, then form the basis of a trial function for use in a variational principle. An example is illustrated. (auth)

20005 FLUCTUATIONS IN A MULTICOMPONENT PLASMA. O. Buneman (Stanford Univ., Calif.). J. Geophys. Research, 66: 1978-9(June 1961).

T. Hagfors' theory of fluctuations in a plasma consisting of electrons and one kind of ion is generalized. The method consists of several species of ions, having charges $Z_1/e/$, $Z_2/e/ \ldots Zk/e/$, masses M_1, $M_2 \ldots$ Mk, and mean number densities $N_{1,0}$, $N_{2,0} \ldots N_{k0}$. The generalization involves inserting the concentrations c_ν where necessary. The procedure is developed for a two-component plasma, 50-50 mixture of singly charged oxygen and hydrogen ions. (P.C.H.)

20006 HYPERFINE STRUCTURE AND ISOTOPE SHIFTS IN THE 2537-A LINE OF MERCURY. Walter G. Schweitzer, Jr. (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 51: 692-3(June 1961).

The hyperfine structure and isotope shifts in the 2537-A line of natural mercury were measured with high precision by interferometric techniques. The etalon spacers used for all but the 201b component were 218.2 and 215.7 mm long. For the 201b component the spacers used were 117.9 and 110.4 mm long. All of the components were measured relative to the 198 component. The results are tabularly presented. A number of pairs of the other components were also measured directly relative to each other. (N.W.R.)

20007 SOME ISOTOPE SHIFTS IN THE SPARK SPECTRUM OF Te. R. H. Hughes (Univ. of Arkansas, Fayetteville), W. A. Hilton, and F. A. Sharpton. J. Opt. Soc. Am., 51: 696(June 1961).

The hollow-cathode spectra from enriched samples of Te^{124}, Te^{126}, and Te^{128} were studied in order to check the isotope shifts in the region of the largest discrepancy to ascertain its nature. Spectral resolution was accomplished by crossing an interferometer with a large quartz-glass spectrograph. The results of the shifts in the line λ4049A of Te II are tabularly presented. The isotope pair shifts for 126-124 and 128-126 are 0.0192 ± 0.0016 and 0.0165 ± 0.0015. The isotopic abundances in the 124, 126, and 128 samples were 83.9, 95.4, and 96.5%, respectively. The 126-124 shift was corrected for the presence of 4.5% of Te^{126} in the 124 sample. The other isotopic impurities were neglected. The errors expressed are limit errors and are considered conservative. (N.W.R.)

20008 FOUNDATIONS OF QUANTUM THEORY AND COMPLEMENTARITY. L. Rosenfeld (Nordisk Institut for Teoretisk Atomfysik, Copenhagen). Nature, 190: 384-8(Apr. 29, 1961).

Complementarity denotes the logical relation between concepts which are mutually exclusive, and which therefore cannot be considered at the same time because that would lead to logical mistakes, but which nevertheless must both be used in order to give a complete description of the situation. The conception of complementarity as an extension of concepts of natural phenomena is discussed. It is pointed out that atomic structures may be described in terms of macroscopic concepts by describing the atomic system in terms of the motions of its parts, or by describing such quantities as volume, pressure, temperature, and entropy, which are related to the laws of thermodynamics. Between these two modes of description there is a relation of complementarity. The author postulates that this complementarity can be formulated in a more general and precise way in a wide-going analogy with the case of quantum mechanics by setting up reciprocal relations between the statistical fluctuations affecting macroscopic quantities. It is pointed out that the reciprocal limitation of the dynamical and thermodynamical modes of description has nothing to do with the quantum of action, and the similarity of the two cases is on the logical level only, since physically they are completely independent. The atomistic view of the world involves in its description two stages of complementarity. The first and most fundamental occurs in the account of the properties of individual atomic systems, and the second when the behavior of systems of large numbers of atoms are described. (C.H.)

20009 INTENSITY ASPECTS AS DETERMINANT OF $r'_e - r''_e$ IN THE BANDS OF THE LANTHANUM OXIDE (LaO) (B ⇀ X) SYSTEM. N. Sreedhara Murthy (Karnatak Univ., Dharwar, India). Nature, 190: 430(Apr. 29, 1961).

The value Δr_e = 0.0378 A was calculated for the (0, 0)

nd in yellow system of LaO. With this value the Franck-ondon factors of other bands were computed, tabulated, d compared with theoretical values. (D.E.B.)

0010 NEUTRON DIFFRACTION INVESTIGATION OF NTIFERROMAGNETISM IN $CrCl_3$. J. W. Cable, M. K. ilkinson, and E. O. Wollan (Oak Ridge National Lab., nn.). Phys. and Chem. Solids, 19: 29-34(Apr. 1961). (In glish)

Observations were made on powder and single crystal mples of anhydrous $CrCl_3$ at temperatures from 298 to ?°K. This hexagonal layer-type crystal undergoes a tran-tion at 16.8°K to an antiferromagnetic state in which the agnetic moments within each hexagonal layer of metal ions e aligned parallel but adjacent layers of moments are op-sitely directed. The axis of spontaneous sublattice mag-tization is closely perpendicular to the c-axis. Observa-ons of the (003) antiferromagnetic reflection in an external agnetic field show that the antiferromagnetism can be de-royed with fields of only a few kilo-gauss, and lead to the nclusion that a net magnetization can be produced with ry small magnetic fields. (auth)

0011 A NEUTRON DIFFRACTION STUDY OF THE EMPERATURE VARIATION OF THE SPONTANEOUS UBLATTICE MAGNETIZATION OF FERRITES AND THE EEL THEORY OF FERRIMAGNETISM. T. Riste and . Tenzer (Brookhaven National Lab., Upton, N. Y.). Phys. d Chem. Solids, 19: 117-23(Apr. 1961). (BNL-4829). (In nglish)

Five different ferrites were studied. Qualitative agree-ent with the Néel theory was obtained in all cases in the spect that the magnetization curve of the tetrahedral ions more convex than the one due to octahedral ions. The ta on magnetite are used in a quantitative analysis in rms of molecular field coefficients. Coefficients deter-ined from conventional magnetic data do not reproduce e sublattice magnetization. This inconsistency is inter-eted as an inability of the molecular field equations to ke proper account of the magnetic interactions. (auth)

0012 SPUTTERING THRESHOLDS. D. E. Harrison, . and G. D. Magnuson (Convair, San Diego, Calif.). hys. Rev., 122: 1421-30(June 1, 1961).

A logically coherent definition of the term "sputtering reshold," and the establishment of criteria that may de-rmine an experimental threshold are attempted. The lsbee chain mechanism and the experimentally observed referred direction of emission from single crystals are ed to establish a threshold theory. Two models are re-uired, one generally applicable when the mass ratio is ss than one, and another when it is greater than one. ngle-crystal threshold laws are obtained, and polycrys-lline laws follow for face-centered cubic crystals by eraging the single-crystal forms. An approximate tech-ique for the evaluation of surface atomic binding energies presented so that the thresholds can be compared with perimental results. In all cases the theoretical thresh-ds are less than or comparable to experimental thresh-ds. (auth)

0013 MOLECULAR MODEL OF THE HEISENBERG XCHANGE INTERACTION. R. K. Nesbet (Boston Univ.). hys. Rev., 122: 1497-1508(June 1, 1961).

The electronic wave function of N_2 is calculated for a eries of internuclear distances, in the simplest approxi-ation, including the principal effects of configuration in-raction. As the internuclear distance increases there is well-defined sequence of regions in which the ground ate is most closely approximated by configurations in which successively more orbitals are represented as localized functions (definitely associated with one of the two atoms) rather than as the odd or even linear combinations of these appropriate to the full molecular symmetry. This corresponds to a continuous change in the nature of the unrestricted Hartree-Fock valence orbitals from molecular to atomic character as the atoms are separated. In the intermediate range of internuclear separation, it is a better approximation to treat some of the valence orbitals as modified atomic orbitals, coupled by an antiferromagnetic Heisenberg exchange interaction, than as molecular orbitals. Various contributions to the Heisenberg "exchange integral," of the kinds considered for the transition metals, are evaluated and compared. It is found that the ordinary direct exchange (which leads to ferromagnetic coupling) is small compared with the sum of the various antiferromagnetic effects, none of which can be described within the traditional Hartree-Fock approximation, which for solids becomes the energy band theory. A method is proposed by which the magnetic interaction in solids could be evaluated quantitatively, by modifying the usual energy band calculations in the same way that the usual molecular orbital theory is modified. (auth)

20014 THE JAHN-TELLER EFFECT FOR LUMINESCENCE CENTERS IN CRYSTALS. N. N. Kristofel. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 20-41 (1960). (In Russian)

The Jahn-Teller effect for luminescence centers in crystals is examined. Concrete calculations are made for the $^3P_1$-state of a center in KCl-Tl. In this case the interaction of the activator with non-totally-symmetrical localized vibrations results in equilibrium symmetry dropping to D_{4h}. Some possible effects arising in this connection are discussed. (auth)

20015 RADIATIONLESS TRANSITIONS IN THE LUMINESCENCE CENTERS OF ALKALI HALIDE PHOSPHORS. K. K. Schwarts, G. K. Vale, and B. Ya. Zunde. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 77-110(1960). (In Russian)

Experimental results are compared with theoretical ideas concerning radiationless transitions in alkali halide phosphors of NaCl, KCl, and KBr, activated by the ions In^+, Sn^{2+}, Tl^+, Pb^{2+}. There are three possible mechanisms of radiationless transitions: thermally activated, optically activated, and tunnel. Experiments reveal only thermally activated radiationless transitions in the case of alkali halide phosphors activated by mercury-like ions. Such transitions cause the well-known thermal quenching of luminescence. Detailed investigation of thermally activated radiationless transitions showed that they conform with the quasi-molecular model of an impurity center: radiationless transitions occur after the establishment of equilibrium between an excited center and the crystalline lattice at vibration levels; radiationless transitions take place across the activating barrier and depend exponentially upon 1/T, where T is temperature. (auth)

20016 SENSITIZED PHOSPHORESCENCE OF NaCl—Tl, Mn. I. V. Yaek. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R. No. 12, 278-80(1960). (In Russian)

The absorption spectrum of NaCl-Tl, Mn (the Mn^{2+} do not exhibit additional absorption bands) and the emission spectrum in the region of $^1S_0 \rightarrow {}^3P_1$ transitions in Tl ions are given. The emission spectrum exhibits two main bands, $^3P \rightarrow {}^1S_0$ in Tl ions and $^4G \rightarrow {}^6S$ in Mn^{2+} ions, and one unresolved band ≈ 370 mμ corresponding to a Tl second center. All the bands appear in the post phosphorescence spectra. The data confirm sensitized phosphorescence in NaCl-Tl, Mn systems. (R.V.J.)

20017 FINE STRUCTURE STUDIES OF NUCLEAR MAGNETIC RESONANCE. N. M. Ievskaya and R. M. Umarkhodzhaev. Vestnik Moskov. Univ., Ser. III, No. 6, 3-7(Nov.-Dec. 1960). (In Russian)

Descriptions are given of the scheme used in the investigation of the fine structure of nuclear magnetic resonance signals. The device provided the means for separate observations of the nuclear magnetic resonance components. Correlations are found between the nuclear magnetic resonance signals in the circuit and the variations of the circuit parameters. It was found that a certain correlation between the high-frequency field amplitude and modulation rate is necessary for undisturbed observations of the fine nuclear magnetic resonance structure. (tr-auth)

20018 RUN-AWAYS IN NEUTRAL GAS. G. Ecker and K. G. Müller (Universität, Bonn). Z. Naturforsch., 16a: 246-52(Mar. 1961). (In German)

The motion of electrons as determined by the field acceleration and the elastic and inelastic collisions with the gas atoms is calculated from the Boltzmann equation. The average velocity and the scattering ellipsoid are derived as a function of time. For particles starting from rest there exists always a critical electric field E_c depending on pressure and temperature. Below this critical value electrons approach the stationary drift process. Above the critical value the electrons do not reach a stationary state, they "run away." For a finite initial velocity v_0 and a field below the critical value E_c the particles are either accelerated to drift, or decelerated to drift, or "run away," depending on the value v_0. From a calculation of the scattering parameters, it is found for $E > E_c$ a focussing effect in the velocity space which increases with field strength. Also the relaxation time for the drift process and the stopping power for electron beams can be calculated. Applications to the glow discharge are discussed. (auth)

20019 STATISTICS OF THE ELECTRON AVALANCHE IN ELECTRONEGATIVE GASES, AT HIGH FIELD STRENGTHS AND LARGE FIELD AMPLIFICATION. Werner Legler (Universität, Hamburg). Z. Naturforsch., 16a: 253-61(Mar. 1961). (In German)

The statistical distribution of the carrier number of single electron avalanches in a Townsend discharge is described by $v(n) = 1/\bar{n} \cdot \exp(-n/\bar{n})$ if one introduces some simplifying assumptions. These assumptions are violated in the case of electronegative gases, in strong electric fields, and in the case of large gas-amplification. In electronegative gases only a part of the primary electrons form observable electron avalanches. These are still subject to an exponential distribution but with an increased mean value. In strong electric fields the ionization probability depends on the previous history of the individual electrons. This leads to a distribution with a marked maximum and a reduced dispersion. In a first approximation the form of the distribution is determined by the quotient $E/\alpha : U_i$. In the case of large gas-amplification the further development of the avalanche is influenced by the space charge and one gets a modified exponential distribution. The calculated distributions agree well with the experiments of other authors. (auth)

20020 THE FINE AND HYPERFINE STRUCTURE OF AMERICIUM-I. K. Krebs and R. Winkler (Technische Universität, Berlin). Z. Physik, 162: 235-44(1961). (In German)

It was previously shown that hfs splitting constants can easily be obtained from experimental data by means of a graphical representation. Here it is shown that this method is also capable of conveniently and unambiguously determining the J values of terms from hfs data. By application of this graphical evaluation method on known hfs measurements of Am-241, the undetermined J value of one Am-I term could be obtained. In four other cases J values were found which differ from the values known so far. The consequences of these redeterminations on the term analysis of the Am are discussed. (auth)

20021 THE THEORY OF MOLECULAR BEAM PRODUCTION IN LONG TUBES. Gerhard Becker (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Physik, 162: 290-312(1961). (In German)

According to a theory of Giordmaine and Wang concerning the formation of molecular beams by long parallel tubes, the peak beam intensity j should be proportional to $N^{1/4}$ (N gas flow rate). This is in contradiction to experimental results on NH_3 molecular beams revealing j proportional to $N^{3/4}$ in a wide range of gas flow rate. It is shown that this relation equally represents best the experimental results of Giormaine and Wang with CO_2 molecular beams. The measured directivities are smaller than the theoretical values and the departures increase with decreasing flow rate and tube diameter. To improve the theoretical statements, the theory of Giordmaine and Wang is extended by consideration of the choking effects of the tube orifices. Another relatively simple theoretical procedure for the evaluation of the directivity of tubes is given using the concept of an "effective tube length." By this method the directivities of several differently formed tubes and of composed beam sources are calculated and compared with the experimental results. The evaluations confirm the experimental observation that sources which are composed of tubes are practically not superior to those which consist of a few slits, the slit width being equal to the tube diameter. Then the remaining discrepancy between the theoretical and experimental results is partly overcome by using the total impact cross section in place of the gaskinetic one. At last the influence of surface diffusion on the tube walls and the effect of the gas cloud in front of the source on the beam formation are discussed. (auth)

20022 THE DEVELOPMENT OF PLASMA WAVES IN STRONGLY IONIZED GASES. Horst Gerstenkorn (Universität, Cologne). Z. Physik, 162: 363-81(1961). (In German)

The development of plain waves in a gas plasma without external fields is considered. The question was recently treated by Landau, v. Kampen, Berz, and others. The Boltzmann equation is discussed and solved explicitly for the case with initial conditions. With the usual expression for the collision term no eigensolutions exist. Nevertheless in a short time long waves develop with $\lambda > 30 l_D$ (Debye length) from the initial distribution; the statistical damping cancels the development of shorter waves. Changing the collision term, one finds true eigensolutions too. This different behavior of the solutions seems to be less a physical problem than a question of the mathematical formalism used. (auth)

20023 THE THEORY OF SECONDARY ELECTRON EMISSION IN METALS. [PART] II. G. Bimschas and G. U. Schubert (Universität, Mainz). Z. Physik, 162: 382-99(1961). (In German)

A transport equation was formulated for the elastically scattered secondary electrons with a simple insertion for elastic scattering in metals. Inelastic scattering acts as absorption and was considered. An inhomogeneous Milne

equation was obtained and it was solved by the Wiener-Hopf method with consideration for various boundary conditions. The ratio of the free path length for elastic and inelastic scattering is a parameter and should be determined by corresponding experiments. (tr-auth)

20024 DERIVATION OF THE QUANTUM RULES ON NON-QUANTAL BASES. Alfred Landé (Ohio State Univ., Columbus). Z. Physik, 162: 410-12(1961). (In German)

The general law of probability interference is only the first step to quantum mechanics; it does not yet contain wave-like periodic traits. The latter enter the theory only through additional dynamic rules for the connection between coordinates and momenta, typified by the wave function $\Psi(p,q) = \exp(2i\pi qp/h)$. This quantum-dynamic rule is shown to be derivable from a non-quantal, non-periodic requirement of invariance of certain quantities with respect to displacement of the zero point in q and p space. (auth)

20025 DETERMINATION OF THE FIRST IONIZATION POTENTIALS OF ATOMS BY THE SURFACE IONIZATION TECHNIQUE. N. I. Ionov and M. A. Mittsev (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 741-2(Mar. 1961). (In Russian)

Results of a study of the surface ionization of atoms of the rare earth metals Er, Tb and Ce and also of the molecule $ThCl_4$ on polycrystalline tungsten are presented. It is shown that the temperature dependence of the ion currents agrees with formulas for surface ionization on composite surfaces. The ionization potentials of the Er, Tb, Ce and Th atoms have been found by comparing these dependences with that for the In positive ion current. (auth)

20026 THE DENSITY OF H_2-D_2 SOLUTIONS. V. N. Grigor'ev and N. S. Rudenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 757-61(Mar. 1961). (In Russian)

The density of the binary system H_2-D_2 has been measured in the range from the melting point to 20.4°K. The relative surplus mixing volumes $\Delta V/V$ are determined. For all solutions $\Delta V/V < 0$ and within the accuracy of the experiments this ratio is independent of the temperature. For an equimolar solution $\Delta V/V \approx -0.01$. The theoretical calculations of $\Delta V/V$ for the H_2-D_2 system do not agree with the experimental data. (auth)

20027 NEUTRON DIFFRACTION STUDY OF THE CRYSTALLINE STRUCTURE OF SOLID HYDROGEN AND DEUTERIUM. V. S. Kogan, B. G. Lazarev, R. P. Ozerov, and G. S. Shdanov (Karpov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1022-6(Apr. 1961). (In Russian)

A neutron diffraction analysis of 12°K confirms the roentgenographic structure of deuterium and the tetragonal structure of hydrogen. The neutron diffraction pattern for hydrogen as well as deuterium was found to be much more involved than the x-ray pattern. This is due to the appearance of interferences at angles which are larger than those at which the intensity of x-ray interference (which sharply drops off with the scattering angle) vanishes and also to the appearance of interferences with an odd sum of indices which are forbidden for body-centered structures consisting of identical particles. The latter fact can be understood if one assumes that ortho and para molecules are arranged in an orderly manner in the lattice and possess different coherent scattering amplitudes for neutrons. In some cases interferences at small angles were observed which could be indexed by assuming that the ortho and para molecules are ordered in a volume containing eight cells. (auth)

20028 STATE EQUATION FOR PARTIALLY IONIZED HYDROGEN. L. P. Kudrin. Zhur. Eksptl'. i Teoret. Fiz., 40: 1134-9(Apr. 1961). (In Russian)

A method is proposed for approximate calculation of the thermodynamic functions of an ionized gas in which account is made for deviations from ideal conditions. The state equation as well as the ionization formula which are derived considerably differ from the Saha formula. (auth)

20029 MODERN ATOMIC AND NUCLEAR PHYSICS. C. Sharp Cook. University Physics Series. Princeton, N. J., D. Van Nostrand Company, Inc., 1961. 305p. $7.75.

A general treatment of atomic and nuclear physics is given. Study is devoted to the atomic nature of matter, properties of the electron, wave-particle dualism, relativity, the Bohr hydrogen atom, and quantum mechanics. Atomic and molecular structures and spectra are examined. Solid-state physics, including electron emission from solids, is investigated. Nuclear properties, reactions, and structure are discussed. Attention is given to radioactivity, and elementary particles are studied. (T.F.H.)

20030 THE SPECTRA OF SOME BETA-EXCITED X-RAY SOURCES WITH THE MULTICHANNEL ANALYZER. Luther E. Preuss, Helen Horn, and Thomas W. Keiser (Edsel B. Ford Inst. for Medical Research, Detroit). p.280-300 of "Advances in X-Ray Analysis. Volume 4." William M. Mueller, ed. New York, Plenum Press, 1961.

Three β-excited x-ray source types (compound, apposition, and mixture source) were designed, and the photon spectra compared. Each source in a series was assembled using a single target element with the concentration of pure β emitter held constant for the series. The apposition source was studied with varying target thicknesses. The compound sources were crystalline precipitates of molybdate and tungstate groups compounded with the noncarrier-free β emitter. The mixture source consisted of a fine-milled target powder with the β emitter adsorbed on it. Assay of the x-ray source emission was done on a 100-channel analyzer with a 3 in. NaI detector. Variation in the spectra exists between the source types of a series. Anomalous peaking occurs with the Sr^{90} MoO_4 source emission at 29 kev. The compound source, potentially productive, demonstrates poor characteristic spectra. (auth)

20031 RADIATION SOURCE. James D. Gow (to U. S. Atomic Energy Commission). U. S. Patent 2,990,476. June 27, 1961.

An improved version of a crossed electric and magnetic field plasma producing and containing device of the general character disclosed in U. S. Patent No. 2,967,943 is described. This device employs an annular magnet encased within an anode and a pair of cathodes respectively coaxially spaced from the opposite ends of the anode to establish crossed field electron trapping regions adjacent the ends of the anode. The trapping regions are communicably connected through the throat of the anode and the electric field negatively increases in opposite axial directions from the center of the throat. Electrons are trapped within the two trapping regions and throat to serve as a source of intense ionization to gas introduced thereto, the ions in copious quantities being attracted to the cathodes to bombard neutron productive targets disposed thereat.

Astrophysics and Cosmology

20032 (NAA-SR-Memo-4615) SATELLITE VEHICLE NATURAL RESTORING TORQUES. T. E. Kapus (Atomics

International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 25, 1959. 23p.

The natural restoring torques on a satellite vehicle are analyzed with a 3-dumbbell configuration approach. The results are applied to the case of a rectangular parallelepiped with a density of 3 lb/ft^3. (D.L.C.)

20033 (NAA-SR-Memo-5961) SPACE BACKGROUND TEMPERATURE AND THERMAL RADIATION. Ernst Treuenfels (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 6, 1960. 11p.

The equivalent space background temperature T_B, defined by $(\Sigma Q/A\sigma\epsilon)^{1/4}$, is needed in the calculation of radiator area for the SNAP-2 program. The method used previously to calculate the irradiation ΣQ for a 300-mile orbit was adapted to the calculation for the case of a 600-mile orbit. Viewfactors for reflected radiation were taken to be equal to those for direct radiation. (D.L.C.)

20034 (NP-10270) THE FEASIBILITY OF TURBULENT VORTEX CONTAINMENT IN THE GASEOUS FISSION ROCKET. M. L. Rosenzweig, W. S. Lewellen, and J. L. Kerrebrock (Space Technology Labs., Inc., Los Angeles). Oct. 17, 1960. 49p. (STL/TR-60-0000-00340)

A semi-empirical analysis was made of the feasibility of containing a gaseous nuclear fuel in a turbulent vortex flow. The analysis is an extension of the laminar diffusion analysis of Kerrebrock and Meghreblian, and includes the experimental information reported by Keyes, concerning the turbulence levels and vortex strengths attainable in jet-driven vortex tubes. It was assumed that the turbulent eddy diffusivity increases the diffusion due to concentration gradients, but has no effect on the diffusion due to pressure gradients. It followed from this assumption that the concentration profile of fissionable gas is broadened, but the position of the maximum concentration is the same as that predicted by the laminar analysis. From the experimental data and this assumption, it was deduced that satisfactory containment of plutonium, or one of its compounds, in hydrogen is possible for certain ranges of the vortex tangential and radial Reynolds numbers. The restrictions imposed on the system by the requirements for nuclear criticality and fission fragment absorption was examined. It was concluded that a vortex reactor providing a significant increase in gas enthalpy over that of the solid fuel nuclear rocket is feasible, however the total system mass is very large, and the thrust to weight ratio is small. Several schemes for increasing the vortex strength, and reducing the turbulence level, are reviewed in the light of these results. Of these, the vortex matrix appears most promising. (auth)

20035 VISCOUS DAMPING OF HYDROMAGNETIC WAVES IN THE CORONA. B. C. Landseer-Jones. Monthly Notices Roy. Astron. Soc., 122: 89-93(1961).

It is suggested that the heat lost by the solar corona is replaced by energy absorbed in the viscous damping of hydromagnetic waves originating in the chromosphere. The energy that the waves, generated by turbulent motion, would carry is approximately 10^8 ergs cm^{-2} sec^{-1}. A frequency for the waves of 10^{-2} sec^{-1}, which seems to be the lowest possible, gives a fall in amplitude by 1/e in 10^{10} cm at 10^6°K. At higher frequencies, the distance for the same fall would be less. The damping is found to be less for smaller inclinations of the wave-normal to the magnetic field. For a dipole type solar field, less energy would therefore be given to the corona over the poles than over the equator. (auth)

20036 Ne IN SOME STONE METEORITES. P. Eberhardt and A. Eberhardt (Univ. of California, La Jolla). Z. Naturforsch., 16a: 236-8(Mar. 1961). (In English)

Ne^{20}, Ne^{21}, and Ne^{22} were measured in several stone meteorites. Good agreement with other cosmic-ray-produced rare gas isotopes was obtained. No indication of primeval neon was found in the chondrites, but one urelite showed excess Ne^{20}. (auth)

20037 Xe^{129} IN THE ABEE METEORITES. J. Zähringer and W. Gentner (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Naturforsch., 16a: 239-42 (Mar. 1961). (In German)

A degassing experiment in steps at different temperatures shows that radiogenic Ar^{40} and primordial Ar^{36} are trapped differently in the Abee enstatite chondrite. Ar^{40} diffuses out easily at low temperatures, while Ar^{36} is released essentially at temperatures higher than 1000°C. Xe^{129} follows the amount of primordial Ar^{36} and the Xe^{129}/Xe^{132}-ratio is 5.5 at all temperatures. This may indicate that all xenon isotopes have been included as primoridal gas and care should be taken to relate it to the iodine content of the present meteorite sample or to add the I–Xe age to the K–Ar age of the meteorite. (auth)

Cosmic Radiation

20038 (NASA-TN-D-700) PRELIMINARY STUDY OF PREDICTION ASPECTS OF SOLAR COSMIC RAY EVENTS. Kinsey A. Anderson (California. Univ., Berkeley). Apr. 1961. 34p.

Several means of anticipating the frequency of solar cosmic-ray emissions were examined, particularly in connection with space exploration by man. One result is that a fairly reliable estimate of the maximum sunspot number at the peak of the next cycle (in 1969) will be available in 1965 or 1966. Large cosmic ray producing flares nearly always appear in a sunspot group that has had, very early in its development, a large unbroken penumbral area. In the events studied, the flares occurred no earlier than 2 days after the appearance of a penumbra above a certain criterion size. On the basis of the prediction means considered here, it appears impossible to guarantee nonencounter with solar cosmic rays in space excursions lasting much longer than 4 days. For longer durations, radiation shielding now appears to be the only feasible approach to safety at times of high sunspot number. (auth)

20039 (NP-tr-611) CONTEMPORARY STATUS OF THE PROBLEM CONCERNING THE ORIGIN OF COSMIC RAYS. V. I. Ginzburg and S. I. Syrovatskii (Syrovatsky) (Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva). Translation. 1960. 117p.

Data concerning the primary component and origin of cosmic rays are summarized. According to concepts based on radioastronomic data, the origin of cosmic rays is mainly galactic; they are generated in flashes of Supernovae and, perhaps, other fixed stars. The chemical composition and energy spectrum of primary cosmic rays near the earth are given. The intensity and frequency spectrum of cosmic radiation were measured to determine the concentration and energy spectrum of relativistic electrons and positrons, constituting the electronic component of cosmic rays. The nuclear lifetime of cosmic rays, the role of cosmic rays produced in the early evolutionary stage of the galaxy, the nature of motion and yield of cosmic rays from the galaxy, cosmic rays of metagalactic origin, the origin of the electronic component of cosmic rays, sources of cosmic rays, the mechanism of acceleration and energy spectrum of cosmic rays, the possibility of preferential acceleration of heavy nuclei, and the transformation of the chemical composition of cosmic rays in the interstellar medium are discussed. (M.C.G.)

20040 COSMIC RAY OUTBURSTS OF NOVEMBER 12th TO 15th, 1960. A. L. Kuz'min, G. F. Krymskii, G. V. Shafer, and Yu. G. Shafer (Lab. of Problems in Physics, Yakutsk Branch, Siberian Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 844-7(Apr. 1, 1961). (In Russian)

A sharp rise in intensity of cosmic radiation was observed at Yakutsk (geomagnetic latitude of 51°N) at 13 hrs 45 min world time (1345 UT) on Nov. 12th, accompanied by a large magnetic storm (1348 UT). The intensity of the cosmic radiation reached a maximum of 65% above the ordinary level at 1630 UT, and was followed by a second emission that started at 1815 UT and reached a maximum of 100% above the ordinary levels at 2000 UT. A third outburst of cosmic radiation began at 0245 UT on Nov. 15th and reached a maximum of about 40% above the ordinary level at 0400 UT on Nov. 15th. A sharp increase in neutron count accompanied these three outbursts of cosmic radiation. The velocity of the emission was about 3×10^8 cm/sec, as determined from the time of delay of the magnetic storm with respect to the increase in intensity of the cosmic radiation. (TTT)

20041 COSMIC RAY PHENOMENA DURING THE NOVEMBER 1960 SOLAR DISTURBANCES. J. G. Roederer (Facultad de Ciencias Exactas y Naturales, Buenos Aires), J. R. Manzano, O. R. Santochi, N. Nerurkar, O. Troncoso, R. A. R. Palmeira, and G. Schwachheim. J. Geophys. Research, 66: 1603-10(June 1961).

A preliminary analysis of cosmic neutron monitor intensity data is presented. The first increase on November 12 is attributed to generation of particles on the sun, following a class 3^+ flare. A second increase on November 12 is interpreted as the arrival at the earth of solar particles trapped in the gas cloud emitted by the sun in connection with a previous flare. The arrival of a further cloud sweeps away the remaining solar particles. The increase on November 15 is attributed to a new generation of high-energy particles by another class 3^+ flare that occurred on the same solar active region. The characteristics of the solar flare increases are shown to agree with the conclusions of McCracken and Palmeira regarding the propagation of solar particles in interplanetary space. Data from low latitude stations are used to investigate the Forbush decreases and their relation with other solar and terrestrial events. (auth)

20042 THE SPECTRUM AND PROPAGATION OF RELATIVISTIC SOLAR FLARE PARTICLES DURING JULY 17-18, 1959. H. S. Ghielmetti (Univ. of Chicago). J. Geophys. Research, 66: 1611-25(June 1961).

During this interval, one solar charged particle intensity increase was definitely observed before a sharp Forbush type decrease, and a second appeared likely following the decrease. These events were detected at sea level and at mountain altitudes. The first event followed the giant solar flare of July 16, and the solar particles appeared to arrive isotropically at the earth. The intensity time dependence of this event showed a slow rise-time comparable with its exponential decay. The integral rigidity spectrum for these particles was approximately $(cp/ze)^{-9}$. The second event, although not uniquely determined as a solar flare event, followed some minor solar flare activity and might be explained by assuming an anisotropy (impact zones for the source in the solar direction) for several hours. The integral rigidity spectrum for this second event was $(cp/ze)^{-4.5}$. This sequence of intensity increases could be explained by the diffusion of solar particles from the July 16 flare through disordered magnetic fields to reach the earth isotropically. The effect of the mechanism for the subsequent Forbush intensity decrease is to smooth the interplanetary fields so as to leave behind only weak, regular fields through which the fast moving solar particles of July 18 arrive anisotropically at the earth. (auth)

20043 RADIATION MEASUREMENTS TO 1500 KILOMETERS ALTITUDE AT EQUATORIAL LATITUDES. Francis E. Holly (Air Forces Special Weapons Center, Kirtland AFB, N. Mex.), Lew Allen, Jr., and Richard G. Johnson. J. Geophys. Research, 66: 1627-39(June 1961).

Three instrument packages containing Geiger tubes were flown into the inner Van Allen belt to altitudes up to 1500 km. Various absorber thicknesses were used to obtain range spectra for penetrating particles. Magnetic separation of electrons and protons was performed on counters with absorber thicknesses ranging from 1.7 mg/cm^2 of mica to 36 mg/cm^2 of aluminum. The electron spectrum observed with counters having electron energy thresholds of 30, 160, 190, and 460 kev appears considerably softer than a neutron β-decay spectrum. Counts in counters with higher thresholds are assumed to be due to trapped protons and the measurements are compared with those obtained with nuclear emulsion experiments on similar trajectories. Absolute flux values are reported. (auth)

20044 EFFECT OF HYDROMAGNETIC WAVES ON THE LIFETIME OF VAN ALLEN RADIATION PROTONS. A. J. Dragt (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Geophys. Research, 66: 1641-9(June 1961).

The effect of hydromagnetic waves upon the motion of charged particles trapped in the geomagnetic field is studied. Application is made to the proton component of the Van Allen radiation belt. It is shown that hydromagnetic waves of low frequency and amplitude are able to account for the rapid decrease in proton flux that delimits the outer edge of the inner zone of the Van Allen radiation belt. Both the location of the boundary of the inner zone and the ratio between the proton fluxes in the inner and outer zones are obtained. Near 2 earth radii from the earth's center, the maximum energy of the trapped protons decreases with geocentric distance as r^{-11}. (auth)

20045 A RELATION BETWEEN SOLAR RADIO EMISSION AND LOW-ENERGY SOLAR COSMIC RAYS. K. Sakurai and H. Maeda (Kyoto Univ.). J. Geophys. Research, 66: 1966-9(June 1961).

A new fact concerning this relation is presented. The traveling time (ΔT), from the sun to the earth, of flare-associated low-energy cosmic rays as a function of the heliographic longitude of corresponding flares implies that the propagation mechanism is not related to the state of interplanetary space. Next the relation of smoothed flux intensity and duration of solar radio waves at (a) 3000 Mc/s and (b) 200 Mc/s was plotted. The plot indicates that (1) there is no relation between the separation in traveling time and the duration of solar radio emission at either frequency and (2) the separation closely correlates to the flux intensity of 3000 Mc/s radio waves. Another figure showing the relation between ΔT and the flux intensity for 3000 and 200 Mc/s radio emission indicates a close connection between the low-energy solar cosmic-ray generation and solar radio emission. From these figures several conclusions are drawn. The ejection and propagation mechanism of cosmic rays in interplanetary space is also discussed. (P.C.H.)

20046 RIGIDITY DEPENDENCE OF SOLAR DIURNAL VARIATION OF COSMIC-RAY INTENSITY. S. P. Duggal, K. Nagashima, and M. A. Pomerantz (Bartol Research

Foundation, Swarthmore, Penna.). J. Geophys. Research, 66: 1970-3(June 1961).

Assuming cosmic rays are preponderantly of galactic origin and that the observed variations in the primary flux are produced by processes of modulation in interplanetary space, various mechanisms are proposed. Amplitudes and times of maxima of diurnal variation determined from pressure-corrected neutron monitor data recorded during August 1957 to July 1958 at various stations were subjected to harmonic analysis. Ottawa was arbitrarily chosen as a standard station to compare the experimental and theoretical results. The result is appreciably different from earlier conclusions. (P.C.H.)

20047 ATMOSPHERIC EFFECTS ON THE INTENSITY OF COSMIC-RAY MESONS. [PART] I. Masami Wada. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 54: 335-52(Dec. 1960). (In English)

A statistical method of obtaining the total barometer coefficient by multiple correlation is proposed. The method is used for the term expressing the temperature effect, with the isobar height measured not from the ground but from the isobar level near the ground as one of the variables for correlation. It is shown that, in addition to the height, the mean temperature obtained by using partial temperature coefficient or the mean mass temperature can also be used in the proposed method. The total barometer coefficient is calculated theoretically as a function of meson momentum, zenith angle, latitude, and altitude. Momentum spectra of mesons and altitude curves of meson intensity, both of which are obtainable by direct measurements, are used as the basis of this calculation. The coefficient thus obtained is rearranged to yield the coefficient for the standard meson monitor. By including latitude and altitude effects, the coefficient for the meson monitor at every existing observatory is derived and listed. A statistical investigation of the barometer effect is carried out using the data obtained at Tokyo. The total barometer coefficient is $-(0.147 \pm 0.003)\%/mb$ which is in agreement with the theoretically estimated value. The coefficient for sea level at high latitudes is found as $-0.17\%/mb$. (auth)

20048 MAGNETIC AND COSMIC RAY STORMS. B. Trumpy (Universitetet, Bergen, Norway). Univ. Bergen Årbok, Naturvitenskap. Rekke, No. 2: 1-29(1959). (In English)

Studies on individual cosmic ray storms in different components of the cosmic radiation were carried out for the Norwegian stations at Tromso and Bergen and for stations in Germany, Japan, and Tasmania. For each component individual cases were investigated regarding increasing phase displacement, with increasing storm time, between the amplitudes of the magnetic and cosmic ray storms. Further, the amplitudes of individual cosmic ray storms were measured for the neutrons, the soft component, the total radiation and for different hard components. In this way, information was obtained regarding the dependence of the amplitude of a cosmic ray storm on the mean energy of the primaries that produced the cosmic ray component in question. Also the dependence of cosmic ray storms on the geomagnetic latitude was investigated for different radiation components. The diurnal variation of cosmic ray storms was studied in a series of cases for different components and for mesons incident from different directions. Special cases of increases of the cosmic ray intensity and their dependence on the geomagnetic latitude were reported for a period of intense solar flare activity, September 18 to 23, 1957. Different possibilities for a theoretical description of the cosmic ray storm phenomena and their connection with solar activity and magnetic storms were discussed. (auth)

20049 SUCCESSIVE INTERACTION OF HEAVY NUCLEI OF PRIMARY COSMIC RADIATION. Ya. Pernegr, Ya. Sedlak, I. Tuchek, and V. Shimak (Physical Inst., Czechoslovak Academy of Sciences, Prague). Zhur. Eksptl'. i Teoret. Fiz., 40: 978-9(Mar. 1961). (In Russian)

The interaction of some of the fragmentation products of heavy nuclei in the beam represent interaction between particles with equal energies, and thus they may yield information on possible asymmetries in the angular distribution. Results of tests made during the 1955 Po Valley expedition with nuclear emulsion are summarized; 6 pairs of successive or parallel cases of interaction of heavy nuclei were found. Results confirm that the number of emitted particles is proportional with the mass of the interacting nuclei. (TTT)

Criticality Studies

20050 (BAW-117) MEASUREMENTS OF THE DANCOFF EFFECT IN H_2O-D_2O MODERATED LATTICES. W. G. Pettus (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Feb. 1960. 22p.

The measurements were made for square lattices of ThO_2 pins of two different spacings. The data are analyzed in a manner which accounts for abstruse and troublesome side effects inherent in the measurements. A comparison is made between the results and theory. (B.O.G.)

20051 (LAMS-2537) CORRELATIONS OF EXPERIMENTAL AND THEORETICAL CRITICAL DATA. COMPARATIVE RELIABILITY, SAFETY FACTORS FOR CRITICALITY CONTROL. Hugh C. Paxton (Los Alamos Scientific Lab., N. Mex.). Mar. 1961. Contract W-7405-eng-36. 54p.

This report supplements LAMS-2415.

Correlations of computed and experimental critical data are discussed. The scope is limited to fissile systems that may be approximated by simple descriptions. The methods used to adjust data to uniform conditions are outlined. The requirements for computation where the values are intended to substitute for experimental data in nuclear safety guidance are described. Computational methods using DSN and multigroup diffusion techniques are discussed. Both computed and experimental data are given for the following: critical masses of bare spheres of uranium with various moderators, critical masses and volumes of homogeneous water-moderated uranium spheres, core-density exponents for water reflected-water moderated U^{235} or Pu^{239} spheres, critical diameters of infinite cylinders of homogeneous water-moderated uranium, critical thicknesses of infinite slabs of homogeneous water-moderated uranium, critical masses of delta-phase plutonium mixtures with water and Plexiglas, influence of Pu^{240} on critical mass of water-moderated plutonium spheres, critical diameters of infinitely-long cylinders and critical thickness of infinite slabs of homogeneous water-moderated Pu^{239}, critical volumes of $U-C-H_2O$ systems, and critical masses of bare spheres of uranium diluted with other metals and graphite. (M.C.G.)

20052 (NAA-SR-5904) REACTIVITY WORTH OF SODIUM IN SODIUM COOLED REACTORS. R. W. Keaten (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 1, 1961. Contract AT(11-1)-GEN-8. 14p.

A simple and accurate method for determining sodium worth in sodium-cooled reactors is an analysis of the measured critical mass with and without sodium in the reactor. Application to both the first and second core loadings of the SRE shows that the amount of control available is more than sufficient to shut down the reactor with the sodium removed. (auth)

Elementary Particles and Radiations

20053 (AFOSR-583) REPORT ON CONFERENCE ON COHERENCE PROPERTIES OF ELECTROMAGNETIC RADIATION HELD AT THE UNIVERSITY OF ROCHESTER, JUNE 27–JUNE 29, 1960. Technical Note No. 5. (Rochester, N. Y. Univ. Inst. of Optics). Apr. 1961. Contract AF49(638)-602. 125p.

Research was presented on various aspects of coherence, especially in connection with coherent scattering, stimulated emission, propagation of partially coherent light, intensity interferometry, and coherence problems of instrumental optics, and of radio astronomy. Abstracts or condensed versions are included for all papers presented at the conference. (B.O.G.)

20054 (CNI-35) LA PRODUZIONE DI PROTONI POLARIZZATI. (Production of Polarized Protons). F. Duinio, A. Luccio, and C. Succi (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Sept. 1960. 96p.

A description is presented of proposals and designs of polarized proton sources with reference to the application of methods based on the magnetic separation of the hydrogen atom hyperfine structure components, and on optical pumping. (auth)

20055 (IA-610) ON THE MULTI-NUCLEON CAPTURE OF K^- MESONS. Y. Eisenberg and M. Friedmann (Weizmann Inst. of Science, Rehovoth, Israel), and G. Alexander and D. Kessler (Israel. Atomic Energy Establishment, Rehovoth). Feb. 1961. 25p.

In a search for fast ($\geq$ 60 Mev) Σ-hyperons emitted from multi-nucleon K^--captures at rest, 65 events were found. Using these events, as well as those published before by other groups were used to set an upper limit of ~6% to the reaction $K^- + n + n \rightarrow \Sigma^- + n$, relative to the total fast (2N)Σ^- production. This was achieved by a study of the distribution of the visible energy associated with K^- stars giving rise to fast identified Σ^+ and Σ^- hyperons. From the visible energy distribution, an unbiased estimate was obtained for the ratio of the $K^- + n + p \rightarrow \Sigma^- p$ and $K^- + p + p \rightarrow \Sigma^+ + n$ reactions. From the Auger-electrons and short prongs associated with the 2N-events and with pion emitting stars it can be shown that, very probably, the total 2N-yield increases significantly with the atomic number of the nucleus in which the K^--capture takes place. A discussion of the results, in view of several proposed models for the multi-nucleon capture process is presented. (auth)

20056 (INSJ-36) THE POLARIZATION IN PROTON–CARBON ELASTIC SCATTERING. S. Suwa, J. Sanada, K. Nisimura, I. Hayashi, N. Ryu, and H. Hasai (Tokyo Univ. Inst. for Nuclear Study). Mar. 27, 1961. 20p.

High-intensity polarized protons of 10^6 sec^{-1}, with low background radiations, were used in measuring the polarization in p-C elastic scattering at 10 to 17 Mev. A change of polarization with energy occurred near 10.5 Mev, which corresponds probably to the resonance as shown in the differential cross-section measurements. (auth)

20057 (JINR-D-685) $K\bar{K}$–PAIR PRODUCTION IN THE $\pi\pi$–COLLISIONS. P. S. Isaev and M. V. Sewerynski (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 11p.

Partial wave equations for $K\bar{K}$ pair production in $\pi\pi$ collisions are obtained using the Mandelstam representation. Solutions of these equations are given in general form. It is shown that the presence of a p-wave resonance in the $\pi\pi$ scattering does not contradict the requirements of the existence or uniqueness of the solutions obtained. (auth)

20058 (JINR-D-696) ON THE FORM FACTOR OF THE π_0 MESON. Dingchang Hsien and Shih-ko Hu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 6p.

The reaction $e^+ + e^- \rightarrow \pi^0 + \gamma$ is considered at very high energies. The form factor, and the contribution of the 3π intermediate state to the form factor, may be found from data on this reaction. (T.F.H.)

20059 (JINR-D-697) THE NEUTRAL MODEL FOR THE INVESTIGATION OF THE PION-PION SCATTERING. A. V. Efremov, H. Y. Tzu, and D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 13p.

The equation describing the scattering of the neutral pseudoscalar mesons in the low energy region is investigated. The solution has two different possible asymptotic behaviors at high energies. The amplitude may decrease as $(\ln E)^{-1}$, corresponding to the results of the renormalizable perturbation theory. The amplitude may also decrease as E^{-4}, corresponding in a sense to the non renormalizable Lagrangian $(\partial_\mu L \partial_\mu L)$. This second class of solutions has several unusual properties, in particular, it shows degeneracy in the limit of the switching off of the interaction. (auth)

20060 (JINR-D-703) τ-DECAY AND $\pi\pi$-INTERACTION. Yu. Vol'f (Wolf) and W. Zöllner (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 14p.

Integral equations are derived for the determination of τ-decay. An effective range analysis gives the values of the s-wave scattering lengths (α) for $\pi\pi$ interaction, which are suitable to reproduce the experimental τ-spectrum. A good fit is obtained for $\alpha_2 = 0.2$ and $\alpha_0 = 0.3$. The values for α_2 and α_0 in combination with the integral equations for $\pi\pi$ scattering indicate the existence of a (T = 2)-resonance of the $\pi\pi$ interaction. (auth)

20061 (JINR-P-240) IZOPROSTRANSTVO I SIL'NOE VZAIMODEISTVIE (Isospace and Strong Interactions). R. Zaikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 12p.

The existence of super-heavy elementary particles is postulated and a modified concept of four dimensional Salam-Polkinghorne theory is presented. The λ hyperon is analyzed as a neutral component of a single triplet containing a $|Z^+, \Omega^-|$ hyperon. A slow decay of super-heavy ω^0 is verified. (tr-auth)

20062 (JINR-P-505) K PRYAMOMU VOSSTANOVLENNYU AMPLITUDY UPRUGOGO RASSEYANNYA. (On the Direct Determination of the Amplitude of Elastic Scattering). G. I. Kopylov and Z. D. Lomakina (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 24p.

A numerical method is developed for resolving the now linear integral equation expressing the complex elastic scattering amplitudes of spin-zero particles. A series of examples confirm the feasibility of replacing phase analysis by the suggested method. (tr-auth)

20063 (NP-10077) GAMMA RAY SCATTERING. Quarterly Technical Progress Report No. 9, December 18, 1960–March 18, 1961. John A. Wethington, Jr., R. A. Karam, and C. A. Bisselle (Florida. Univ., Gainesville). Mar. 18, 1961. Contract NOas-59-6013-c. 11p.

Mathematical models were developed for the conversion of pulse-height distribution from monochromatic sources to photon spectra. (B.O.G.)

20064 (NYO-2854) APPLICATION OF DISPERSION RELATIONS TO THE PHOTODISINTEGRATION OF THE DEUTERON. Bunji Sakita (Rochester, N. Y. Univ. and Wisconsin. Univ., Madison), and Charles J. Goebel (Rochester, N. Y. Univ.). Apr. 10, 1961. Contract AT(30-1)-875. 39p.

The calculation of the matrix element of the process $\gamma + d \rightarrow n + p$ by dispersion techniques is considered. There are twelve invariant amplitudes; the covariant form of the transition amplitude is related to the noncovariant (Pauli matrix) form, and this is further related to partial wave amplitudes, keeping however only the dipole amplitudes. The Born terms of the dipole amplitudes are derived, and the dispersion relations for the dipole amplitudes are written down and solved in a low energy approximation in which the n-p final state rescattering is taken into account, but no other higher order effects. In an appendix these calculations are performed directly in the nonrelativistic limit to illustrate the essential simplicity of the technique. No light is shed on the well known discrepancy between theory and experiment for the threshold M1 amplitude; the nearest (anomalous) singularities, at least, will have to be included in order for the dispersion calculation to be sufficiently accurate. But we remark that the form of the amplitude implies a correlation between the threshold value of the amplitude and its energy dependence, a correlation that would be interesting to check experimentally. (auth)

20065 (TID-12762) THE SPIN OF THE MU-MESON. P. K. Kabir (Carnegie Inst. of Tech., Pittsburgh). 1961. 4p.

An extension is given of the Hughes study [Phys. Rev. Letters 5 63(1960)] of the formation and observation of muonium through its Larmor precession, which shows that the experiment provides a measurement of a spin of 1/2 for the μ^+–mesons. (B.O.G.)

20066 (AEC-tr-3971(p.96-145)) MEETING ON THE PHYSICS OF HIGH-ENERGY PARTICLES. Translated from Uspekhi Fiz. Nauk, 61: No. 1, 103-28(1957).

The papers presented at the Meeting on the Physics of High-Energy Particles held in Moscow, May 14 to 22, 1956 are briefly summarized. Topics under which the papers were grouped include meson (π) formation by nucleons, interactions of nucleons with nucleons, interactions of mesons (π) with nucleons, interactions of nucleons with nuclei, photonuclear reactions, and new particles. (M.C.G.)

20067 (AEC-tr-3971(p.160-236)) THEORY OF MULTIPLE SCATTERING OF GAMMA-RAYS. V. S. Galishev, V. I. Ogievetskii, and A. N. Orlov. Translated from Uspekhi Fiz. Nauk, 61: No. 2, 161-216(1957).

A systematic exposition of published methods for theoretical study and calculation of multiple scattering of gamma rays is presented. The elementary processes in the interaction of gamma quanta with absorbing material were examined briefly. Quantities which characterize gamma radiation are defined and the relations between them derived. The radiation transport equation and the expansion of photon density in Legendre polynomials are discussed. The methods of polynomial expansion, small-angle approximation, and other approximation methods are described in detail. (M.C.G.)

20068 (AEC-tr-3971(p.380-402)) ON PARITY NONCONSERVATION IN β-DECAY. I. S. Shapiro. Translated from Uspekhi Fiz. Nauk, 61: No. 3, 313-30(1957).

It is shown that the concept of intrinsic asymmetrical "screw" particles is not the only way to explain nonconservation. The possibility that the τ and θ mesons are essentially identical particles, in the decay of which the law of parity conservation is violated, is discussed. The phenomena in which parity violation can be observed are outlined. The possible causes leading to parity nonconservation are discussed. A forward-backwards asymmetry of the angular distribution of electrons emitted in β decay of Co^{60} and μ mesons indicated parity nonconservation. The problem of nonconservation and its relation to the structure of space is also discussed. (M.C.G.)

20069 (AEC-tr-3971(p.403-94)) PIONS (A SURVEY OF EXPERIMENTAL DATA). L. M. Barkov and B. A. Nikol'skii. Translated from Uspekhi Fiz. Nauk, 61: No. 3, 341-98(1957).

Basic experimental data on the properties of mesons (π) and their interactions with nucleons and nuclei are reviewed and summarized. The properties of pions, scattering of pions by nucleons, pion production in nucleon-nucleon collisions, the production of pions by the interaction of nucleons and photons, interaction of pions with nuclei, photoproduction of pions by nuclei, and pion production by interaction of a free nucleon with a nucleon in the nucleus are discussed. (Two hundred and twenty six references.) (M.C.G.)

20070 (AEC-tr-3971(p.550-86)) STRANGE PARTICLES (THE ISOTOPIC MULTIPLET SCHEME). L. B. Okun'. Translated from Uspekhi Fiz. Nauk, 61: No. 4, 535-59(1957).

The classification of elementary particles by the isotopic multiplet scheme and the problems related to the isotopic spin of strange particles are discussed. The following topics are included in this survey: masses and decay schemes of mesons (K) and hyperons; main features of strange particles; types of interactions; isotopic spin of mesons (π), nucleons, mesons (K), and hyperons; strangeness; strong interactions $\Delta S = 0$ and $\Delta T = 0$; electromagnetic interactions $\Delta S = 0$; strange particle decays $\Delta S = \pm 1$ and $\Delta T = \pm 1/2$; and other possible particles in the isotopic multiplet scheme. (M.C.G.)

20071 (UCRL-Trans-479) THREE ELECTRON μ MESON DECAY. I. I. Gurevich, B. A. Nikol'skii, and L. V. Surkova. Translated from Zhur. Eksptl'. i Teoret. Fiz., 37: 318-19(1959). 2p.

Observations on three-electron μ meson decay are presented. Included are observations pertaining to electron ranges in the pellicle, angles between electrons, decay interpretations, and occurrence probabilities. (J.R.D.)

20072 (UCRL-Trans-655) EMISSION OF γ-QUANTA DURING THE COLLISION OF FAST π-MESONS WITH NUCLEONS. L. D. Landau and I. Ya. Pomeranchuk. Translated from Zhur. Eksptl'. i Teoret. Fiz., 24: 505-15(1953). 28p.

The emission cross section of γ quanta produced in the diffraction of π mesons and their capture by nucleons is determined by studying the wave function of the π meson outside of the nucleon. This wave function is found in the form of the sum of the plane wave and the wave diffracted from the nucleon which is considered as a "black" ball. The case of "gray" nucleons which only partially absorb mesons is also considered. (D.L.C.)

20073 A CRITERIUM FOR THE STABILITY OF A NEUTRAL ZERO SPIN PARTICLE PREDICTED BY A CLASSICAL NONLINEAR FIELD THEORY. Olavi Hellman (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A. VI., No. 71, 1-9(1961). (In English)

A stability theory is suggested for the neutral zero-spin elementary particles predicted by a generalized nonlinear field equation. The application of the theory to the lightest elementary particle predicted by the cubic equation results in the instability of this particle, in an agreement with phase-plane calculations. (auth)

20074 A CLASSICAL NONLINEAR FIELD THEORY PREDICTING MASSES OF NEUTRAL AND CHARGED ELEMENTARY PARTICLES WITH ZERO SPIN. Olavi Hellman (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A. VI, No. 72, 1-12(1961).

A method is introduced for calculating the electromagnetic correction to the masses predicted by a classical nonlinear scalar field theory. Only by taking into account the electromagnetic field is it possible to calculate from experimental data all three unknown constants of a classical nonlinear field theory of this kind. Furthermore, calculations that neglect the electromagnetic field lead to a mass spectrum in which the charged particles are always heavier, in contradiction with the experimental results, that $M_{\pi^0} < M_{\pi^\pm}$ but $M_{K^0} > M_{K^\pm}$. Calculations are carried out for the case of a cubic field equation. The three constants of the theory are obtained from the π meson data; the masses of the neutral and charged particles, corresponding to the next eigensolution of the field equation, are calculated. It turns out that the neutral particle is now heavier. The cubic equation does not predict the masses of the π^0 and the K^0 mesons correctly. The problem is formulated for a more general nonlinearity (Φ^{2N-1} instead of Φ^3). It is noted that future calculations might reveal an N-value which would lead to the correct π^0 and K^0 masses. (auth)

20075 MODIFIED FLAMMERSFELD RANGE ENERGY RELATION FOR ELECTRONS. S. P. Khare and Y. P. Varshni (Allahabad Univ., India). Ann. Physik, (7) 7: 220-4(1961). (In English)

Flammersfeld range energy relations for electrons in aluminum have been shown by Varshni and Karnatak to be satisfactory only above 0.2 Mev. The relation, after suitable modification, was extended to the low energy region. The modified relation yields satisfactory results down to 2 kev and passes smoothly to its original form above 0.2 Mev. The observed values were compared with the theoretical results of Nelms. For a given energy, the observed range is smaller than the theoretical range. (auth)

20076 INTERACTION OF 560-Mev NEGATIVE π-MESONS WITH EMULSION NUCLEI. Å. Frisk, S. Nilsson, B. E. Ronne, and W. Schneider (Univ. of Uppsala). Arkiv Fysik, 19: 69-82(1961). (In English)

Interactions of 560 π^- with emulsion nuclei were investigated. 4454 stars were found by area scanning. These yield an interaction mean free path of processes including absorption, charge exchange scattering, and inelastic scattering of 28 ± 2 cm. 485 stars were analyzed in detail. The frequency of stars with charged pions is 33 ± 4% where those with no heavy prong were excluded. The average kinetic energy of pions from stars with one negative pion is 176 ± 20 Mev. A marked correlation exists between the pion energy and the angle of emission. Eight events with two charged pions and ten with one positive pion were found. A rough estimate gives a fraction of events with charged pion production of 7 ± 4%. (auth)

20077 ANTINEUTRON ANNIHILATIONS OBSERVED IN NUCLEAR EMULSIONS. C. Castagnoli, C. Lamborizio, and I. Ortalli. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 167-73(1960-1961). (In Italian)

Seven stars produced in the annihilation of antineutrons in nuclear emulsions exposed to the Berkeley Bevatron are analyzed. Up to the present only two stars of $\bar{n}$ have been described, one in a bubble chamber and one in an emulsion by Tsai-Chu. It was not possible to obtain detailed information on either the method of annihilation or the production. The results, however, showed that nuclear emulsions are a good detector of antineutrons. (tr-auth)

20078 ON THE CONSERVATION OF ISOFERMIONS AND THE RULE $\Delta S = \Delta Q$ IN WEAK PROCESSES. W. Królkowski (Inst. of Theoretical Physics, Univ. of Warsaw and Inst. for Nuclear Research, Polish Academy of Sciences). Bull. acad. polon. sci., Sér., sci., math., astron. et phys., 9: 43-5(1961). (In English)

The equivalence of the conservation laws for strangeness ($\Delta S = 0$) and isofermions ($\Delta Y = 0$) in strong and electromagnetic interactions is noted. The concept of strangeness is applied to leptonic (weak) interactions. Selection rules $\Delta Y = 0$ and $\Delta S = \Delta Q$ are proposed for weak interactions. The rule $\Delta S = \Delta Q$ is concluded to be more closely in agreement with experiment than the rule $\Delta Y = 0$. (T.F.H.)

20079 ON THE ASYMPTOTICAL FORMULA FOR THE THERMODYNAMICAL POTENTIAL OF FERMI PARTICLES. J. Czerwonko (Wrocław Univ., Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 99-101 (1961). (In English)

The Hamiltonian of a system of fermions is given. A Bogoliubov-type canonical transformation, followed by a diagonalization, yields the asymptotically true thermodynamic potential of the system. The assumption is made that $\lim_{N\to\infty} N/V$ is finite, where N is the number of fermions and V is the system volume. (T.F.H.)

20080 SOME EXPERIMENTS ON GAMMA-RAY BACKSCATTERING. Tomonori Hyodo (Kyoto Univ.) and Sakae Shimizu. Bull. Inst. Chem. Research, Kyoto Univ., 39: 180-88(Mar. 1961).

Backscattered radiation was observed by a scintillation spectrometer for Co^{60} and Cs^{137} point sources in contact with paraffin, Al, Fe, Sn, and Pb. Contributions to backscattered rays from single and double or multiple Compton scattering of incident γ rays were clarified. Intensity of backscattered radiation was measured as a function of scatterer thickness. Although the experimental arrangement was not so simple that exact analysis of observed data could be performed, experimental findings were interpreted qualitatively by theoretical predictions. Thus the experimental results may afford some valuable information on experiment arrangement, apparatus, and facilities. (auth)

20081 QUANTIZATION OF THE MOVEMENT OF THE RELATIVISTIC ROTATOR. Francis Halbwachs. Compt. rend., 252: 1907-12(Mar. 27, 1961). (In French)

The quaternionic representation of the Lorentz transformation proposed previously is utilized to express the dynamic variables characterizing a relativistic rotator. On quantizing by the ordinary method it is seen that the angular movement engenders a system of complex conjugated operators in which the eigenfunctions are evident. The effect of the invariance of space and time as well as charge conjugation are studied. (tr-auth)

20082 THE CLASSICAL MODEL OF BOPP AND HAAG FOR PAULI PARTICLES. Jean Penne (Institut Henri

Poincare, Paris). Compt. rend., 252: 1913-15(Mar. 27, 1961). (In French)

It is shown how the introduction of the variables Ψ, θ, and φ, Euler angles describing the orientation of an arbitrary trihedral bound to the spherical symmetrical structure of the particle, permits the recovery of the Bopp and Haag results on the model of the turning electron. The case of particles with arbitrary spin is considered. (J.S.R.)

20083 RADIATION DECAY OF CHARGED π MESON. A. I. Mukhtarov, R. G. Eilanbekov, and S. A. Gadzhiev (Inst. of Physics, USSR). Doklady Akad. Nauk Azerbaidzhan. S.S.R., 16: 935-40(1960). (In Russian)

The radiative decay $\pi \rightarrow \mu$ for S and P variation in direct interaction was previously investigated considering the anomalous magnetic moment of μ. Calculations were made of polarization and angular distribution of decay products. The decay $\pi \rightarrow e$ for the same variation was also studied without consideration for particle polarization and anomalous electron magnetic moment. Calculations show that the terms stipulated by the magnetic moment at nearly equal numerical coefficients are proportional, m_π/m_μ for $\pi \rightarrow \mu$ and m_π/m_e for $\pi \rightarrow e$. Hence, their contribution in the second decay will be more pronounced than in the first. The derived generalized expression for $\pi \rightarrow \mu$ probability holds also for $\pi \rightarrow e$ when the μ magnitudes are replaced by e. The analysis indicated that nonrelativistic approximation of μ in $\pi \rightarrow \mu$ and relativistic approximation for e in $\pi \rightarrow e$ does not change the general results. Assuming that π decays according to $\pi \rightarrow e + \nu + \gamma$, it is shown that the most probable decay takes place when e and γ are emitted in the same direction; decay with e and γ emitted in opposite directions is most improbable. (R.V.J.)

20084 PROTON-PROTON SCATTERING BELOW 20 Mev. R. G. Herb (Univ. of Wisconsin, Madison). Experientia, 17: 193-9(1961). (In English)

A history of p-p scattering experiments below 20 Mev is presented. It is noted that the p-p interaction is ambiguous, in that odd $\underline{1}$-states of the incident beam produce complex effects on the target. Combinations of p- and d-wave interactions can be fitted to experimental data. Polarization effects are noted. The necessity and potentiality for greater measurement accuracy are discussed. Methods are outlined for increasing accuracy by improving beam monochromatism and collimation, by improving detectors and analyzer apertures, and by refining auxiliary measurements. (T.F.H.)

20085 TOTAL IONIZATION IN GASES BY HIGH-ENERGY PARTICLES: AN APPRAISAL OF OUR UNDERSTANDING. R. L. Platzman (Université, Paris). Intern. J. Appl. Radiation and Isotopes, 10: 116-27(Apr. 1961). (In English)

Three different methods for calculating W are outlined, and all are applied to the case of helium. Application of the theories together with experimental data to other gases and to gaseous mixtures yields new information on cross-sections for inelastic collisions of charged particles with atoms and molecules, and even on an important optical property of the medium. The theories also provide the first trustworthy information on the total numbers of various products formed in the absorption of high-energy radiations. (auth)

20086 CHARGED PARTICLE EMISSION IN MEDIUM WITH PERIODICALLY VARYING DENSITY. A. Ts. Amatuni and N. A. Korkhmazyan (Erivan State Univ., [USSR]). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: No. 5, 55-64(1960). (In Russian)

Charged particle losses in a medium with periodically varying density were previously analyzed. A different method is used for determining particle energy losses on Cherenkov emission. A medium where electron density N changes periodically along the z axis but remains constant along the perpendicular axis, $N = N_0(1 + k\cos(2\pi z/e))$, $0 < k < 1$, was investigated. Some of the derived expressions are applied in evaluating charged particle energy losses per unit of path length. Finally, the proportional terms Δ in the expression for particle electric field intensity are studied in order to calculate the variable force acting upon the particle. (R.V.J.)

20087 PHOTONEUTRON SOURCES. H. A. Sandmeier (Argonne National Lab., Ill.). Kerntechnik, 3: 167-8(Apr. 1961). (In German)

Most photoneutron sources used at present contain beryllium as the target material, more rarely deuterium. The photon sources are obtained by activation of suitable materials, such as antimony, in a reactor. For determination of the neutron yield the photoneutrons are compared with absolutely calibrated neutron sources. The yield depends largely on the volume and on the geometry of the target and gamma emitter and its activity. (tr-auth)

20088 DERIVATION OF THE BOLTZMANN TRANSPORT EQUATION FOR INELASTIC COLLISIONS. P. N. Argyres (Massachusetts Inst. of Tech., Lexington). Phys. and Chem. Solids, 19: 66-72(Apr. 1961). (In English)

A quantum-mechanical derivation for inelastic collisions is given along the lines Kohn and Luttinger developed for elastic collisions. It is shown that for Fermi–Dirac particles the scattering in the collision term of the transport equation is restricted to unoccupied states only, in contradistinction to the case of elastic collisions. (auth)

20089 ANGULAR DISTRIBUTIONS OF $T(p,n)He^3$ NEUTRONS FOR 3.4- TO 12.4-Mev PROTONS. M. D. Goldberg, J. D. Anderson, J. P. Stoering, and C. Wong (Univ. of California, Livermore). Phys. Rev., 122: 1510-13(June 1, 1961). (UCRL-6205)

Angular distributions of the neutrons from the $T(p,n)He^3$ reaction were obtained for incident laboratory proton energies of 3.4, 4.3, 5.0, 6.5, 8.0, 8.8, 10.3, 11.5, and 12.4 Mev. The neutrons were detected by a plastic scintillator, and standard time-of-flight techniques used to separate the monoenergetic neutron group from background neutrons and gamma rays. The distributions in the center-of-mass system showed substantial backward peaking. Above about 8 Mev proton energy, a broad maximum appeared at about 80° (c.m.) and persisted through the highest energy measured. (auth)

20090 COHERENT SCATTERING OF 1.17-Mev AND 1.33-Mev GAMMA RAYS THROUGH SMALL ANGLES. P. P. Kane and G. M. Holzwarth (Wesleyan Univ., Middletown, Conn.). Phys. Rev., 122: 1579-84(June 1, 1961).

The dependence of the differential cross section for the coherent scattering of 1.17 Mev and 1.33 Mev gamma rays on atomic number is investigated. An empirical procedure, which makes an absolute determination of the cross sections unnecessary, is used to estimate the Compton scattering cross sections. The latter are subtracted from the measured cross sections in order to obtain the relative coherent scattering cross sections, which are found to vary as Z^n. The average value for n is 3.07 ± 0.18. The angular distribution of the total (coherent and Compton) scattering cross section was also investigated in the case of copper and lead between 2.43° and 5.79°. Results are compared with theoretical predictions and with results of earlier experiments. (auth)

20091 PHASE-PARAMETER REPRESENTATION OF NEUTRON-PROTON SCATTERING FROM 13.7 TO 350 Mev. M. H. Hull, Jr., K. E. Lassila, H. M. Ruppel, F. A. McDonald, and G. Breit (Yale Univ., New Haven). Phys. Rev., 122: 1606-19(June 1, 1961).

Results of gradient searches for phase parameters representing neutron-proton scattering were reported. The number of "measurements" used in the final searches was 293 with 35 additional ones used to obtain composite values. Most of the fits joined reasonably smoothly to the $^3S_1$ phase shift curve at low energies. The validity of charge independence was assumed and the more probable among the T = 1 phase-parameter sets, obtained in a previously described series of searches for phase-parameter fits to p-p data, were therefore employed for this T. The one-pion exchange values were used for the larger L and J. Independent sets of searches started with phase parameters corresponding to the Gammel-Christian-Thaler potential, and the Gammel-Thaler potential, respectively. The procedure was varied by employing a weighted mean of fits obtained from the two different starting points as a new starting set and other devices described in the text. The final fits were appreciably better than the starts, the mean square deviation being reduced by a factor ~20 in some cases. A rough division of the final fits into related families according to the behavior of the parameters K_3 and ρ_3 could be made. The value of additional measurements and especially those of the triple-scattering parameters and polarization correlation was pointed out. Tests on reasonableness of one of the better fits from the point of view of representation by a static potential were made, with satisfactory results. (auth)

20092 HYPERON DECAY IN THE NONLEPTONIC MODE. Seitaro Nakamura (Tokyo Univ. and Nihon Univ., Tokyo) and Michiji Konuma. Phys. Rev., 122: 1620-3 (June 1, 1961).

An interaction Hamiltonian of the weak interaction between baryons and pions is described in the three-dimensional charge space. In order to determine the types of interaction, a conservation law of extended chirality is speculated; the branching ratios and the absolute lifetimes of the nonleptonic hyperon decays are calculated and the results are compared with the experiments. (auth)

20093 PHOTOPRODUCTION OF MESONS FROM HYDROGEN AND DEUTERIUM. Robert W. Kenney, Edward A. Knapp, Victor Perez-Mendez, and Walton A. Perkins (Univ. of California, Berkeley). Phys. Rev., 122: 1631-3 (June 1, 1961). (UCRL-9491)

The relative yields of positive pions produced from hydrogen and deuterium by a 340 Mev bremsstrahlung beam are measured in the laboratory system at angles of 20, 40, and 60°, and at pion energies from 45 to 145 Mev. The ratio of the relative yields of pions from deuterium and hydrogen is roughly constant as a function of angle, but decreases monotonically with pion energy from a value of 0.90 ± 0.05 at 45 Mev to a value of 0.55 ± 0.07 at 145 Mev. Comparison with the phenomenological theory of Chew and Lewis indicates a gradual change from nucleon spin flip near threshold to no-spin-flip transitions above 140 Mev. Comparison with Uretsky's calculation involving final states shows fair agreement with plane-wave and shape-independent approximations. Poor agreement with the zero-range approximation shows that final-state interactions are important in the theory of photoproduction of pions from deuterium. (auth)

20094 SINGLE SCATTERING OF 2-Bev/c MUONS IN NUCLEAR EMULSIONS. C. Y. Kim, S. Kaneko, Y. B. Kim, G. E. Masek, and R. W. Williams (Univ. of Washington, Seattle). Phys. Rev., 122: 1641-5(June 1, 1961).

The single scattering of high-energy muons from emulsion nuclei was measured using a monoenergetic beam of muons. The median momentum of muons was 2.00 ± 0.03 Bev/c with a spread of no more than ±3.5%. The muon tracks recorded in nuclear emulsions were followed by a special fast-scanning technique, and a total of 682 single scattering events were found from 743 meters of track following. For the muon beam accepted in the emulsion scanning, the pion contamination was measured to be 1.3 ± 0.2%. These pions contributed to the integral muon scattering data by about 3% for scattering angles greater than 1°. The observed scattering distribution (up to 3° scattering angle), or momentum transfer of about 100 Mev/c, was in agreement with the electromagnetic theory predictions. (auth)

20095 K^-–D ABSORPTION AND A $\pi-\Sigma$ RESONANCE. R. L. Schult (Cornell Univ., Ithaca, N. Y.) and R. H. Capps. Phys. Rev., 122: 1659-62(June 1, 1961).

The branching ratios for the $K^- + d \rightarrow \pi + Y + N$ reactions are compared with those for the $K^- + p \rightarrow \pi + Y$ reactions. Certain of these deuteron branching ratios are shown to be independent of hyperon-nucleon final state interaction and are inconsistent with the proton branching ratios. The most likely explanation of the discrepancy is the presence of an isospin zero $\pi-\Sigma$ resonance a few Mev below the $K^- + p$ threshold. (auth)

20096 A POSSIBLE SYMMETRY IN SAKATA'S MODEL FOR BOSON–BARYONS SYSTEM. [Part] III. Mineo Ikeda (Hiroshima Univ., Takehara, Japan), Yoshihiko Miyachi, Shuzo Ogawa, Shoji Sawada, and Minoru Yonezawa. Progr. Theoret. Phys. (Kyoto), 25: 1-16(Jan. 1961).

In the full symmetry theory a physical system can be characterized by six quantum numbers. Following the original intention of the composite model, an attempt is made to replace these quantum numbers by others that are easier to understand by intuition. This study leads to a new picture of the particle, which contrasts with the usual picture in the perturbation theoretical treatment. The realistic aspects developed not only promote a deeper understanding of the full symmetry theory of the composite model, but also throw a new light on the structure of elementary particles. (auth)

20097 ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. Ken Kawarabayashi (Univ. of Tokyo) and Shigeru Machida. Progr. Theoret. Phys. (Kyoto), 25: 17-34(Jan. 1961).

Spectral representations of the electromagnetic form factors of the nucleon for fixed momentum transfer are obtained as a function of the square of the four-momentum of the nucleon, based on the general principles of the quantum field theory. Using these representations, two sets of coupled equations for charge and magnetic moment form factors are derived. These equations are solved in an approximation in which only the lowest mass configuration is taken into account, consisting of one pion and one nucleon. It is shown that the absorptive parts in this approximation are expressed in terms of the real pion production by a virtual photon for $I = J = \frac{1}{2}$ state and pion-nucleon vertex part, from which it follows that the (3-3) resonant state does not contribute to the form factors as far as the lowest mass configuration is concerned. (auth)

20098 ELECTROMAGNETIC MASS SHIFT OF Σ HYPERONS. Hiroshi Katsumori (Osaka Gakugei Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 25: 159-61(Jan. 1961).

It is found empirically that $\frac{1}{2}(M_{\Sigma^+} + M_{\Sigma^-}) - M_{\Sigma^0} = (1.2 \pm$

0.4) Mev = f(M), where M is the mass of the subscripted particle. A calculation is performed to order e^2, which yields the result f(M) = 0. In the calculation, vertex relations deduced from strong interaction symmetry properties are used, and the assumption is made that the direct pion current dominates the isovector part of the vertex. Explanations for the observed fact that f(M) ≠ 0 are proposed, including effects of K meson currents, π meson contributions, etc. (T.F.H.)

20099 THE QUESTION OF SUBATOMIC PARTICLES AND ANTIPARTICLES. J. Balta Elias (Universidad, Madrid). Rev. univ. ind. Santander, 2: 203-11(1960). (In Spanish)

A complete discussion of subatomic particles and antiparticles is presented. The classification of particles and their principal characteristics, a review of the discovery of the antiproton and antineutron, interactions between particles, and the modern concepts on the subject are included. (auth)

20100 QUANTUM-FIELD EVALUATION OF MULTIPLE PARTICLE PRODUCTION MODEL. B. T. Vavilov. Vestnik Moskov. Univ., Ser. III, No. 6, 46-53(Nov.-Dec. 1960). (In Russian)

A model is suggested for quantum-field evaluation of multiplicity without using perturbation theory. The method of resolving initial equations, evaluation of inelasticity coefficients in the examined process, and analysis of the scheme from the point of view of the Feynman diagram are discussed. The relation of the coefficient of inelasticity to the number of produced mesons is expanded for evaluating the multiplicity at lower energies (up to 10^{11} ev). Results obtained for the case of pseudovector bond are included. (R.V.J.)

20101 CHERENKOV EMISSION OF A PARTICLE POSSESSING A CHARGE AND MAGNETIC FIELD. Mêngha Li. Vestnik Moskov. Univ., Ser. III, No. 6, 78-80(Nov.-Dec. 1960). (In Russian)

Classical methods are applied for determining the energy loss of particles possessing charge and magnetic moment and in motion in a ferromagnetic material. The data are divided into Cherenkov and ionization energy losses. An expression was derived for the Cherenkov energy losses. (tr-auth)

20102 THE CALCULATION OF THE MASS OF FERMIONS IN A NON-LINEAR SPINOR THEORY. Arif-Uz-Zaman (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 225-7(Mar. 1961). (In German)

The contraction function $[0|T\psi_\alpha(x)\bar{\psi}_\beta(x')|0]$ occurring in the nonlinear spinor theory of Heisenberg was approximated by assuming that the density function $\rho(\zeta)$ contains a normal particle state at $\zeta = \kappa^2$ and a dipole ghost at $\zeta = m^2$. This assumption is slightly more general than that in the original paper where the mass of the dipole ghost was taken as $\zeta = 0$. The intention of the present calculation was to see whether the approximation could be improved in this way and whether a certain inconsistency mentioned in the earlier paper would disappear. The nucleon mass value $\kappa_N l$ is calculated in the lowest approximation of the new Tamm–Dancoff method. It is shown that only for m^2/κ^2 less than about 0.05 are real values of $\kappa_N l$ obtained, i.e., the dipole ghost has to be assumed at zero mass or very near to it. The inconsistency of the method mentioned in earlier work still persists. (auth)

20103 PRODUCTION OF Ξ^--HYPERONS BY 7 AND 8 Bev/c π^--MESONS. Kang-cha'ng Wang, Ts'u-tsiang Wang, N. M. Viryasov, Ta-ts'ao Ting, Hi In Kim, E. N. Kladnitskaya, A. A. Kuznetsov, A. Mihul, Nguyen Dinh Tu, A. V. Nikitin, and M. I. Solov'ev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 734-40(Mar. 1961). (In Russian)

The production and decay of Ξ^--hyperons obtained in the interaction between π^--mesons and propane at momenta of 6.8 ± 0.6 and ~8 Bev/c were studied. Altogether 11 Ξ^--hyperons have been observed. Their decay energies Q, lifetimes τ_0 and production cross sections are presented. (auth)

20104 MARSHAK INVARIANCE AND FOUR-FERMION INTERACTION. H. Yiglane (Inst. of Physics and Astronomy, Academy of Sciences, Estonian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 782-3(Mar. 1961). (In Russian)

A baryon and lepton classification is proposed which may be employed to describe weak interaction processes. The Marshak analogy is extended to all baryons and leptons. (auth)

20105 ELECTRODYNAMICS OF A ZERO MASS SPINOR PARTICLE. V. G. Vaks. Zhur. Eksptl'. i Teoret. Fiz., 40: 792-800(Mar. 1961). (In Russian)

The electrodynamics of a zero mass two-component particle with a charge e_1 is considered. Despite a number of singularities, the theory is not internally inconsistent and is as complete as the ordinary electrodynamics. A rough experimental estimation yields $e_1 \lesssim 10^{-8}$ e. The possibility of existence of a charge e_1 in familiar neutrinos is discussed. (auth)

20106 ON THE EMISSION OF LOW ENERGY γ-QUANTA BY ELECTRONS SCATTERED ON PROTONS. S. M. Bilen'kii and R. M. Ryndin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 819-25(Mar. 1961). (In Russian)

The emission of low energy γ-quanta in ep-scattering is considered. It is shown that the first two terms of the expansion of the amplitude in powers of the photon energy can be expressed through the electromagnetic form-factors of the proton. The differential cross section for the process is derived in this approximation. (auth)

20107 ON THE THIRRING MODEL. F. A. Berezin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 885-94(Mar. 1961). (In Russian)

The four-fermion Thirring model is considered. The problem of determining the field operators is solved by functional quadrature. (auth)

20108 RELATIVISTICALLY CONVAIANT RELATIONS BETWEEN POLARIZATION EFFECTS IN THE SCATTERING OF SPIN ½ PARTICLES. G. V. Frolov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 943-5(Mar. 1961). (In Russian)

The relations between all quantities characterizing polarization effects in the scattering of different, as well as identical, particles with spin ½ are derived in a relativistically covariant form. (auth)

20109 OBSERVATIONS ON THE ANISOTROPY OF ANGULAR DISTRIBUTION OF PARTICLES IN NUCLEAR INTERACTIONS WITH ENERGIES OF ~10^{12} ev. M. Votruba, Ya. Pernegr, M. Suk, and V. Shimak (Physical Inst., Czechoslovak Academy of Sciences, Prague). Zhur. Eksptl'. i Teoret. Fiz., 40: 976-7(Mar. 1961). (In Russian)

On the basis of data published in the literature it was attempted to show that interactions with charged (p) particles result in a greater anisotropy than with neutral (n) primary particles. It is deduced that the average anisotropy of the p group is enhanced by the mesons produced

hile the n group represents only interactions due to neu-
ons. (TTT)

0110 INVESTIGATION OF THE SPECTRUM AND SYMMETRY OF ELECTRONS FROM THE $\pi \rightarrow \mu \rightarrow e$-ECAY IN A NUCLEAR EMULSION. A. O. Vaisenberg, . A. Smirnitskii, and E. D. Kolganova. Zhur. Eksptl'. i eoret. Fiz., 40: 1042-9(Apr. 1961). (In Russian)

The energy spectrum and spatial asymmetry of positrons rom the $\pi^+ - \mu - e$-decay in a photographic emulsion located n a magnetic field have been measured. The value obtained r the Michel parameter $\rho = 0.66 \pm 0.07$ and the asymme-y parameter $\delta = 0.63 \pm 0.12$ are in agreement with the eory of the two-component neutrino. (auth)

0111 COMMUTATION FUNCTION OF A NONLINEAR ESON FIELD. D. Ivanenko and D. F. Kurdgelaidze (Mos-ow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1072-5 Apr. 1961). (In Russian)

A new definition of the commutation function, being -radial-symmetric solution, is proposed. Nonlinear meson elds are considered and, in particular, an expression for e commutation function is presented. (auth)

0112 DOUBLE DISPERSION RELATIONS AND PHO-OPRODUCTION OF π-MESONS. N. F. Nelipa (Lebedev st. of Physics, Academy of Sciences, USSR). Zhur. ksptl'. i Teoret. Fiz., 40: 1085-92(Apr. 1961). (In ussian)

An integral equation set has been obtained for the partial hotoproduction amplitudes. It differs from that previously ound in that besides the partial amplitudes for scattering f π-mesons on nucleons it also contains the partial ampli-ides for annihilation of a nucleon pair into two π-mesons nd the photoproduction of π-mesons on π-mesons. These mplitudes are related to the partial amplitudes for scat-ering of π-mesons on π-mesons. (auth)

0113 NUCLEON-NUCLEON INTERACTION AT AN NERGY OF 9 BeV. I. M. Gramenitskii, I. M. Dremin, . M. Maksimenko, and D. S. Chernavskii (Lebedev Inst. of hysics, Academy of Sciences, USSR). Zhur. Eksptl'. i eoret. Fiz., 40: 1093-1100(Apr. 1961). (In Russian)

The pole approximation is employed to describe periph-ral collisions of nucleons at an energy $E_\pi = 9$ Bev. The esults of the calculations are compared with the experi-ental data and the agreement is found to be satisfactory. he region of applicability of the pole approximation is es-mated and the possibility of obtaining information on the roperties of the π-meson propagation function and πN-nteraction cross section as a function of the square of the -meson 4-momentum (k^2) is discussed. (auth)

0114 PHASE SHIFT ANALYSIS OF pp-SCATTERING T ENERGY OF 95 MeV. V. A. Borovikov, I. M. Gel'fand, . F. Grashin, and I. Ya. Pomeranchuk. Zhur. Eksptl'. i eoret. Fiz., 40: 1106-11(Apr. 1961). (In Russian)

A five-parameter analysis of the experimental data on p-scattering at 95 Mev (cross-section, polarization, de-olarization) is performed by a new numerical method (the ravine" method). A broad complex range of solutions is btained which cannot be described by specifying the local inima and error matrices as in the well known "local" echnique. The region obtained can be divided into two omparatively small regions by including some data on otation of polarization R, obtained by extrapolating from nergies of 150, 210, and 310 Mev. (auth)

0115 DISPERSION RELATIONS FOR THE VERTEX ARTS. Yu. M. Malyuta (Inst. of Physics, Academy of ciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 0: 1128-33(Apr. 1961). (In Russian)

The primitive diagrams are derived and the positions of the nearest singularities for the $\Lambda\Lambda\pi$, $\Lambda\Sigma\pi$, and $\Sigma\Sigma\pi$ vertex parts are determined by aid of the Nambu-Symanzik major-ization method. The investigation differs from that carried out by Nambu for the hyperon form factor in that we do not restrict ourselves to a consideration of the simplified model but consider the case in which all strongly interact-ing particles participate. (auth)

20116 UNSTABLE PARTICLE IN THE LEE MODEL. Ya. B. Zel'dovich. Zhur. Eksptl'. i Teoret. Fiz., 40: 1155-9(Apr. 1961). (In Russian)

An unstable particle capable of undergoing real decay $V \rightarrow N + \theta$ is considered in the nonrelativistic second quantization theory (Lee model). Perturbation theory and the expansion of an arbitrary state in eigen states are ex-tended to the case of an unstable particle. The quantity which plays the role of the state norm of such a particle is determined. A new method is proposed for determining the fraction of time a stable particle V′ capable of undergoing the virtual transformation into $N + \theta$ stays in the state V′ and in the state $N + \theta$. If the method is applied to an un-stable particle V, one can find the time it is in each of the two states, but the answer is expressed in complex num-bers. (auth)

20117 EQUATIONS FOR THE SPHERICAL FUNCTIONS OF CHARGED π-MESONS. Yu. A. Simonov and K. A. Ter-Martirosyan (Inst. of Experimental and Theoretical Phys-ics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1172-8(Apr. 1961). (In Russian)

The scattering amplitude for charged π-mesons on π-mesons is expressed with aid of the Mandelstam repre-sentation in terms of the spectral functions. An equation set is derived for spectral functions which depend on one or on two variables. One of the methods of approximate solution is discussed. (auth)

20118 THE $\pi + d \rightleftharpoons 2N$ PROCESS ACCORDING TO THE DRESSED PARTICLE TECHNIQUE. M. A. Braun (Leningrad State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1179-84(Apr. 1961). (In Russian)

The $\pi + d \rightleftharpoons 2N$ process is considered from the stand-point of the nonrelativistic theory of πN-interaction in the P-state. The amplitude can be expressed in terms of the coupling constant and the πN-scattering P-phase shift by application of the dressed particle technique. The depend-ence of the calculated cross sections on energy and angle qualitatively agrees with the experiments. At angles far removed from 90° and at not too large energies the maxi-mal discrepancy between the theoretical and observed cross sections is 30%. For angles close to 90° and energies ap-preciably exceeding the resonance energy, the ratio of the calculated cross section to the experimental one is as high as 2. In order to obtain more refined results πN-interaction in the S-state and high nucleon velocities should be taken into account. (auth)

Neutron Physics

20119 (AFSWC-TN-60-38) THE TRANSPORT OF NEUTRONS THROUGH THE ATMOSPHERE FROM A MONOENERGETIC SOURCE VERSUS TIME OF FLIGHT. Ellen M. Hippeli (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Dec. 1960. 93p.

A set of tables is presented depicting the theoretical neutron-energy spectrum per initial neutron as a function of transport time for a burst height of 125,000 feet and six sampling altitudes ranging from 50,000 feet to 125,000 feet. The calculations are based on a Monte Carlo Code. In the

majority of cases, the peak flux occurs in the first 2 milliseconds for initial neutron energies of 14, 10, and 5 Mev; however, for an initial energy of 2 Mev, the peak usually occurs between 3 and 5 milliseconds. (auth)

20120 (AFSWC-TN-61-2) THE TRANSPORT OF NEUTRONS THROUGH THE ATMOSPHERE FOR A BURST HEIGHT OF 50,000 FEET. Alexander E. Anthony, Jr. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Jan. 1961. 45p.

A series of curves is presented showing the scattered and direct neutron flux per initial neutron from a burst height of 50,000 feet and sampling altitudes from 30,000 to 100,000 feet. The data for the curves were calculated from a Monte Carlo Code. (auth)

20121 (CNEN-37) ESAME COMPARATIVO DEI CONTATORI PROPORZIONALI AL TRIFLUORURO DI BORO E DELLE CAMERE A FISSIONE IMPIEGATI NEL CONTROLLO DEI REATTORI NUCLEARI. (Comparative Estimation of Boron Trifluoride Proportional Counters and Electron-Collection Fission Chambers Used for the Control of Nuclear Reactors). L. Sani, and F. Zanchi (Italy. Comitato Nazionale per L'Energia Nucleare, Ispra). Dec. 1960. 65p.

The operational characteristics of boron trifluoride proportional counters and fission chambers were analyzed experimentally in consideration of their use as thermal neutron flux detectors for nuclear reactor control. Particular attention was paid to the examination, from theory and experiment, of the possibilities of inherent differentiation between neutron and gamma radiation, with regard to the build-up of gamma pulses into the resolving time of the pulse counting systems. The continuous comparison of these two widely used types of neutron counters has afforded the definition of their operating ranges. (auth)

20122 (NAA-SR-Memo 5563) APPLICATION OF P1MG TO THERMAL NEUTRON FLUX CALCULATIONS IN HYDROGENOUS SHIELDS. D. S. Duncan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 4, 1960. 45p.

A method is described by which a code (P1MG), in conjunction with fast neutron removal theory, is used to predict the thermal neutron flux distributions in both the hydrogenous and the non-hydrogenous portions of a reactor shield. The results obtained from the application of this method are compared with the results calculated using four-group diffusion theory and with those obtained by experimental measurement in shields composed of water, iron and water, and graphite, iron, and titanium hydride. Based on these comparisons, it is concluded that the P1MG method is generally accurate to within a factor of two of the measured thermal neutron distributions in the shields studied, and in addition, offers considerable improvement over few-group diffusion theory. (auth)

20123 (NAA-SR-Memo-5889) FINITE DIFFERENCE APPROXIMATIONS TO THE NEUTRON DIFFUSION EQUATION. H. P. Flatt (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 8, 1960. 19p.

The finite difference approximations used in several one-dimensional neutron diffusion codes are studied from the point of view of conservation of neutrons. A new set of approximation formulas is proposed which conserves neutrons and which differs only slightly from earlier formulas. (auth)

20124 (PAN-198/I-B) PARASITIC REFLECTIONS IN NEUTRON MONOCHROMATORS. K. Blinowski and J. Sosnowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 12p.

The intensity of a monoenergetic neutron beam obtained by reflection from a crystal monochromator is very often decreased due to the additional so-called parasitic scatterings. Since this effect gives several percent fluctuations of the intensity, it has to be taken into account in precise measurements. In particular it is important in neutron spectrum studies by Bragg reflection. For a given reflecting plane two parameters are responsible for multiple scattering: Bragg angle and spatial orientation of monochromator. Suitable choice of the second parameter eliminates parasitic reflection. A Cu monochromator was rotated about axis perpendicular to the (111) reflecting plane. The intensity of reflected thermal neutrons was measured versus angle of rotation. Results showing the influence of multiple reflections were found to agree with calculated angular positions for chosen Bragg angles. (auth)

20125 (TID-11823) FLUX MEASUREMENTS IN THE BATTELLE MEMORIAL INSTITUTE FAST-NEUTRON ACTIVATION FACILITY. P. W. Schreiber and D. T. James (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 1, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 22p. (XDC-61-1-103)

Fast neutron foil activation traverses were run in the No. 4 6-in. beam hole of the Battelle Memorial Institute reactor. Foil activation and integral neutron fluxes are reported for the foil shield tank filled with water and isopropyl biphenyl. These liquids provided sufficient neutron spectrum hardening to indicate the relative activation threshold energies for the various materials. (auth)

20126 CALCULATIONS OF THE NEUTRON AGE IN WATER AND HEAVY WATER FOR D-D SOURCES. John W. Cooper (National Bureau of Standards, Washington, D. C.). Nuclear Sci. and Eng., 10: 1-10(May 1961).

Calculations of the age to indium resonance of neutrons from the reaction $D(d, n)He^3$ in water and heavy water are performed by the Monte Carlo method. The calculations are designed to simulate experiments. The effect of the duct used to lead the deuteron beam into the medium is investigated. The computations show agreement with experimental results. (auth)

20127 AGE TO INDIUM RESONANCE FOR D-D NEUTRONS IN HEAVY WATER. V. Spiegel, Jr. and A. C. B. Richardson (National Bureau of Standards, Washington, D. C.). Nuclear Sci. and Eng., 10: 11-15(May 1961).

The neutron age to the 1.44-ev resonance in indium has been determined from activation measurements for a $D(d, n)He^3$ neutron source in 99.8% heavy water. Appropriately averaged and corrected indium foil activities yield the value 119.1 ± 1.5 cm^2 for the age in an infinite medium. Independent theoretical calculations for exactly this experimental arrangement all yield values in agreement with this experimental result. It appears, therefore, that there is at present no discrepancy between theory and experiment for the age of 2-3 Mev neutrons in heavy water. (auth)

20128 SOME CALCULATIONS OF THE AGE OF NEUTRONS IN D_2O. Herbert Goldstein and Jeremiah Certaine (Nuclear Development Corp. of America, White Plains, N. Y.). Nuclear Sci. and Eng., 10: 16-23(May 1961).

The moments method is used to calculate the flux age at 1.44 ev, in D_2O and D_2O-H_2O mixtures, of neutrons from various point isotropic sources. For the neutrons from a D-D source averaged over-all solid angle and operating at a deuteron energy of 200 kev, the age in 99.8% D_2O is com-

puted to be 118.6 ± 1.2 cm^2, in agreement with experiment. The rate of change of age for this source with very small admixtures of H_2O is found to be −4.5% per 1% H_2O. Flux ages to 1.44 ev are also calculated for seven monoenergetic point sources from 2.00 to 2.98 Mev in energy. The approximate linearity of these ages with source energy is used to show that uncertainties in the angular distribution of the D-D source neutrons have a negligible effect on the averaged age. It is also shown that the 2.4 Mev antiresonance in oxygen is manifested in the age in D_2O only as a correction to the first flight term. (auth)

20129 A TWO-MODE VARIATIONAL PROCEDURE FOR CALCULATING THERMAL DIFFUSION THEORY PARAMETERS. G. P. Calame, F. D. Federighi, and P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng., 10: 31-9(May 1961).

A variational procedure for calculating thermal cross-sections and diffusion theory parameters is described. The method permits the calculation of an approximate lethargy-dependent Wigner-Wilkins flux spectrum for a region, as a linear combination of two lethargy- and temperature-dependent base spectra. The coefficients for linearly combining the base spectra are provided by the theory and once the coefficients are calculated the flux is determined. The average microscopic cross sections and diffusion theory parameters for the region are calculated from a flux weighted average of lethargy-dependent microscopic cross sections and diffusion constants. Cross sections and diffusion theory parameters calculated in this manner agree well with those obtained from the SOFOCATE code. (auth)

20130 U^{238} EPITHERMAL CAPTURE IN PWR-1 BLANKET CLUSTERS. W. Baer (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 57-60(May 1961).

A measurement of the epithermal radiative capture in U^{238} is carried out in a natural UO_2-fueled blanket cluster of the nuclear mock-up of PWR Core 1. Analysis indicates that a substantial increase (~20%) in epithermal captures in a natural uranium metal plate fuel cluster should occur in the fuel elements adjacent to a wide intercluster water channel. The experiment shows that the captures in a cylindrical UO_2 fuel element at the edge of the bundle is only 7% greater than in a neighboring fuel element. However, the radial distribution of captures in the first fuel rod shows that the captures near the wide intercluster water channel are 65% greater than at an equivalent position on the side of the rod away from the water channel. Calculations of the relative epithermal U^{238} captures in the cluster show that diffusion theory predicts the spatial dependence of the captures in the interior of the cluster but fails near the edge of the bundle. Monte Carlo analysis confirms the observed increase in the captures in a fuel rod at the edge of the bundle, although the precision of the analysis does not make a quantitative comparison feasible. (auth)

20131 FAST NEUTRON ENERGY SPECTRA IN GRAPHITE-MODERATED REACTORS. Mark T. Robinson, O. S. Oen, and D. K. Holmes (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 10: 61-9(May 1961).

As an aid to the interpretation of radiation damage phenomena, calculations are made of the energy spectrum of the fast neutrons in graphite-moderated reactor systems. A detailed study of the effect of scattering symmetry on the slowing down of neutrons from monoenergetic sources in homogeneous systems shows the importance of including a reasonably accurate representation of the scattering symmetry in estimates of fast neutron spectra. The neutron collision density and the flux density are computed for fission neutrons slowing down in an infinite, homogeneous graphite reactor. The effects of source heterogeneity are examined by applying age theoretical methods to the ORNL Graphite Reactor. The results of the calculations are in agreement with the limited amount of experimental data available. (auth)

20132 THE FAST EFFECT IN URANIUM AND BERYLLIUM SYSTEMS. Herbert Rief (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 10: 83-9(May 1961).

A Monte Carlo code is used to calculate the fast fission factor ϵ and the fast fission ratio δ in both homogeneous and heterogeneous systems. The following results are obtained: for an infinite block of natural uranium, $\delta = 0.39$, $\epsilon = 1.247$; for an infinite block of beryllium, $\epsilon = 1.078$; for beryllium oxide, $\epsilon = 1.046$. In addition, results are given for homogeneous mixtures of uranium and beryllium. Calculations are also carried out for uranium-water lattices and compared with experimental results for slightly enriched uranium rods and slabs, and uranium oxide rods. Other results show the increase in ϵ when uranium fuel elements are surrounded by beryllium cladding of varying thickness. (auth)

20133 ON THE CALCULATION OF WATER GAP PEAKING. Gerald P. Calame (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng., 10: 90-1(May 1961).

Standard calculations of power peaking near water gaps yield larger relaxation lengths and smaller power peakings than the observed values for these quantities. These discrepancies result from a poor representation of the spatially dependent thermal neutron spectra. A method is described for improving the accuracy of these peaking calculations, consisting of computing the thermal group constants in the reactor by everywhere averaging the cross sections over the infinite medium characteristic spectrum of the water gaps. The method is incorporated into a computer program. The method is unsuccessful if the ratio of fission cross section to activation cross section is spectrally dependent. (T.F.H.)

20134 COUPLED SQUARE WELL MODEL FOR ELASTIC SCATTERING. D. E. Bilhorn (Rice Univ., Houston, Tex.) and W. Tobocman. Phys. Rev., 122: 1517-20(June 1, 1961).

A simple model for s-wave neutron scattering is provided by representing the scattering potential by a pair of coupled square wells. Such a model produces resonances that exhibit the giant resonance effect. Isolated resonances given by this model are compared for two types of coupling with the Breit-Wigner formula. For a resonance with a width of about 16 kev, the resonant part of the scattering does have the Breit-Wigner form. The resonance energy is found to be considerably shifted from the energy of the bound state that exists in the zero-coupling-strength limit. Also the nonresonant part of the scattering amplitude is considerably different from both the hard-sphere scattering amplitude and the zero-coupling-strength limit scattering amplitude. This last result is in accord with expectations based on R-matrix theory. (auth)

Nuclear Properties and Reactions

20135 (AERE-R-2938(2nd.Ed.)) RADIOISOTOPE DATA. R. A. Allen, D. B. Smith, and J. E. Hiscott (United Kingdom Atomic Energy Authority. Research Group. Wantage Radiation Lab., Harwell, Berks, England). Jan. 1961. 199p.

Revised data are presented on cyclotron and reactor produced isotopes, fission products, and some naturally occurring radioisotopes. The list of reactor-produced isotopes is enlarged to include materials of particular interest in activation analysis. More information is included for cyclotron-produced isotopes of interest in medical applications. (B.O.G.)

20136 (AFOSR-173) MAGNETIC DIPOLE MOMENTS OF ODD-A NUCLEI IN THE SPHERICAL REGION. N. Freed and L. S. Kisslinger (Western Reserve Univ., Cleveland). 1960. 22p.

The magnetic dipole moments of odd-A nuclei are calculated and compared with the experimental data for nuclei with particles in the 28-126 shells, except for the deformed region of $150 \leq A \leq 190$. The wave functions upon which the calculation is based are admixtures of seniority one wave functions produced by a pairing interaction and obtained by projecting eigenfunctions of the number operator out of Bardeen-type wave functions. Perturbation theory is used to compute the seniority three admixtures produced by a delta-function residual interaction. (auth)

20137 (AFSWC-TR-61-15) FAST NEUTRON CROSS SECTIONS OF OXYGEN AND NITROGEN. Final Report. L. F. Chase, Jr., R. V. Smith, R. G. Johnson, F. J. Vaughn, and M. Walt (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif). Feb. 1961. Contract AF29(601)-1765. 105p. (LMSD-895076)

Results of research toward measuring the neutron cross sections for N and O in the neutron energy range from 4 to 12 Mev are presented. New techniques for the use of low-yield and multiple-group neutron source reactions, which were developed to perform these measurements, are shown, along with additional data obtained for the neutron source reactions $Be^{9}(\alpha,n)C^{12}$ and $N^{15}(d,n)O^{16}$. In addition to the $N^{14}(n,d_0)C^{13}$ reaction measurements, the $C^{13}(d,n)N^{14}$ reaction was investigated to provide additional deuteron stripping data for evaluating the spins and parities of the low-lying states of N^{14}, and to provide additional information on the reaction mechanism for deuteron induced reactions. Measurements and results are given for the differential elastic, total, and nonelastic neutron cross sections for nitrogen and oxygen at several neutron energies. (auth)

20138 (CF-61-5-55) THE PRODUCTION OF Ge^{68}. Geoffry I. Gleason and John L. Need (Oak Ridge National Lab., Tenn.). May 16, 1961. 9p.

Production of Ge^{68} by the Ga^{69} (p,2n) reaction is reviewed. Present production targets are described and yields given. The thick target yield measured with an external beam is 16.7 mc/ma-hr for 20.7-Mev protons. A proposed target system is described. (D.L.C.)

20139 (GA-2010) EMISSION OF GAMMA RADIATION AS A FUNCTION OF TIME AFTER PHOTOFISSION OF U^{238}. Final Report. R. B. Walton (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 11, 1961. Contract AF29(601)-2768. (AFSWP-TR-61-10). 38p.

The intensity of delayed gamma rays from the photofission of U^{238} was measured from 30 μsec to 8 sec after fission. Photofissions of U^{238} were induced by allowing a well-collimated x-ray beam to strike a uranium sample. The x rays originated in a thin tungsten target which was bombarded by a pulsed beam of 20-Mev electrons from a high-current linear accelerator. A plastic scintillation detector was used to detect all delayed gamma rays at greater than 250 kev. The measurements show that the delayed gamma-ray intensity falls by a factor of about 100 between 30 μsec and 800 μsec after fission, then remains almost constant to about 0.5 sec, beyond which time it decreases at a rate consistent with earlier results. Since the apparent half-life of the decay at early times is about 80 μsec, the gamma rays associated with this period probably arise from the decay of one or more fission products formed in isomeric states. Measurements repeated with a bias energy of 510 kev showed the same initial decay characteristic, indicating that some of the gamma rays contributing to the short-lived component have energies greater than 500 kev. In an attempt to evaluate neutron backgrounds using a mercury sample, gamma rays with energies less than about 500 kev and an apparent half-life of 102 μsec were observed. The gamma rays probably resulted from the decay of a mercury reaction product not previously reported. (auth)

20140 (NP-10075) THE NUCLEAR PROPERTIES OF RHENIUM. Quarterly Technical Progress Report No. 5. John A. Wethington, Jr. and R. A. Karam (Florida. Univ., Gainesville). Mar. 8, 1961. Contract NOas-60-6021-c. 12p.

Measurements were made of the inelastic scattering γ-ray yield from fast neutron reactions with rhenium and iron. The production and attenuation of γ rays associated with thermal-neutron absorption in rhenium and lead were calculated for an incident flux of one neutron per second per cm^2. (B.O.G.)

20141 (NP-10271(p.1-11)) ELASTIC SCATTERING OF 6.7-Mev NEUTRONS FROM SILVER AND INDIUM. P. R. Malmberg and S. C. Snowdon (Naval Research Lab., Washington, D. C.).

A method of successive iteration is used to approach the corrected differential cross section from the experimentally determined uncorrected cross section. The corrected curves are integrated to give the total elastic scattering cross section. The results are 2.11 barns for silver and 2.08 barns for indium. The measurements of total cross sections gave 4.33 barns for silver and 4.39 barns for indium at 6.8 Mev. Indium scattering corrections are made. In spite of the small statistical uncertainties, the uncertainty in the total cross section values is perhaps 2 percent (mainly because of electronics instability). (N.W.R.)

20142 (NYO-2962) NONADIABATIC CHANGES OF POTENTIAL AND NEUTRON PRODUCTION IN FISSION (thesis). Robert W. Fuller (Princeton Univ., N. J. Palmer Physical Lab.). April 1961. Contract AT(30-1)-937. 138p.

The possibility of release of prompt neutrons in fission processes by nonadiabatic changes in the nuclear potential in the dividing nucleus is treated. A square well containing a Fermi sea of nucleons in the middle of which is "erupting" an inverted square well "volcano" is considered. The transition between adiabatic and sudden energy transfer to nucleons is analyzed. By varying the ratio of the volcano width to the square well width or by smoothing the volcano out in space, the number of particles ejected can be changed. The results are applied to the case of Cf^{252}. (D.L.C.)

20143 (OOR-1784:20) APPLICATION OF A SIMPLIFIED BRUECKNER TECHNIQUE TO NUCLEAR MATTER. Technical Report No. 4. Bruce Laurence Scott (California. Univ., Los Angeles). June 1960. Contract DA-04-495-ORD-1648. 117p.

The problem of computing the average energy per particle of nuclear matter from some postulated interaction consistent with known two-body data is considered. The Brueckner method of modifying perturbation theory for hard-core potential treatment and some of the properties of its reaction matrix are considered. In order to solve

e problems introduced by the Pauli and dispersion effects the nuclear medium, the Brueckner method uses com-icated devices, and an alternative way of potential sepa-ation is outlined. It is shown how the separation is made uantitatively and enables the nuclear reaction matrix to e expanded in a converging series. The separation method used to study the properties of nuclear matter assuming mple central potentials, and more realistic wells includ-g tensor and spin-orbit interactions are discussed. D.L.C.)

0144 (ORO-406) IONIZATION AND CHARGE TRANS-ER CROSS SECTIONS. PHASES I AND II: H^+ IONS INCI-ENT ON He, Ne, Ar, H_2, N_2, O_2, AND CO TARGETS. echnical Status Report No. 7, March 1, 1961 to May 31, 961. E. W. McDaniel, J. W. Hooper, D. W. Martin, and . S. Harmer (Georgia Inst. of Tech., Atlanta. Engineering xperiment Station). June 1, 1961. Contract AT(40-1)-591. 81p.

The gross ionization cross sections for protons incident n He, Ne, Ar, H_2, N_2, O_2, and CO were measured for inci-ent particle energies over the range 0.15 to 1.10 Mev. he experimental values are presented along with other ata which are available in the energy range below 0.18 lev. The results fit the equation $\sigma_i = A\, E^{-C}\, cm^2$/molecule ith the exception of CO which, however, fits the equation t energies above 0.4 Mev. The constants A and C were omputed from the experimental data. The results for H_2 re in excellent agreement with the extension of the Born pproximation of the $H^+ + H^0 \rightarrow H^+ + H^+ + e^-$ process to the olecular case. Excellent agreement is also obtained be-ween the cross section data and those for incident electrons f the same velocity as the protons for which the data were ollected. (D.L.C.)

0145 (PAN-120/I-A) GAMMA SPEKTR Tu^{165}. Gamma Spectrum of Tm^{165}). S. Khoinstskii, A. Yasinskii, a. Kovnatskii, G. Lantsman (Polish Academy of Sciences. nst. of Nuclear Research, Warsaw) and I. A. Yutlandov Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1959. p.

The γ spectrum of Tm^{165} was investigated. The γ transi-ons 243, 292, 352, 453, 810, 1172, and 1398 kev observed reviously were confirmed. A new line 2007 kev was found nd the relative intensities of 1172:1398:2007 kev = 1 : 0, 3 : 0,06 were estimated. (tr-auth)

0146 (PAN-196/VII) THE EFFECT OF THE EX-CLUSION PRINCIPLE ON THE REAL PART OF THE OPTICAL POTENTIAL. J. Dabrowski and A. Sobiczewski Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 16p.

The real part of the optical potential for nucleon-nucleus scattering was calculated in the frame of the Watson heory. The Pauli principle was taken into account by ex-cluding the intermediate states occupied by target nucleons rom the scattering equation. The first correction to the eal part of the optical potential, resulting from the Pauli rinciple, was expressed by the nucleon-nucleon phase hifts. Numerical results were obtained for the Signell-Marshak phase shifts. At medium energies the depth of the eal part of the optical potential increased appreciably ecause of the Pauli principle. (auth)

0147 (TID-11824) NEUTRON CROSS SECTIONS FOR AMARIUM-149 AND REVISED NEUTRON CROSS SEC-IONS FOR NATURAL SAMARIUM. J. W. Zwick (General lectric Co. Aircraft Nuclear Propulsion Dept., Cincin-ati). Nov. 15, 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 14p. (XDC-61-1-113)

Group-averaged, discrete-energy and Maxwell-averaged microscopic neutron cross sections for natural Sm and Sm^{149} and discrete-energy and Maxwell-averaged macroscopic neutron cross sections for natural Sm are presented. The methods followed in the processing of the cross sections are outlined and a comparison with other compilations is given. A summary of sources of data available as of Nov. 1959 is included. (auth)

20148 (TID-12682) POSITIVE PARITY STATES OF Be^9 AND C^{13}. F. C. Barker (Australian National Univ. Research School of Physical Sciences, Canberra and Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). 1960. Contract AT(301-1)-2098. 56p.

The states produced by weakly coupling a 2s or 1d neutron to a core consisting of the ground or first excited state of C^{12} are mixed by means of a two-body central interaction and a one-body spin-orbit interaction of the type normally used in intermediate-coupling calculations, to provide the low-lying positive-parity eigenstates of C^{13}. The positions and neutron widths of the states agree satisfactorily with experimental data, as do the calculated cross sections for photoneutron disintegration of C^{13}, however in order to obtain agreement with other data involving E1 radiative widths the single-particle shell-model wave functions must be modified so as to have the correct asymptotic form. Similar calculations are performed for the Be^9 positive-parity states, about which little is known experimentally. (auth)

20149 (TID-12726) PROGRAM 15-2, A MONTE CARLO CALCULATION OF GAMMA RAY SCATTERING IN AIR. N. R. Baumgardt, A. Trampus, and J. E. MacDonald (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 1961. Contracts AF 33(600)-38062 and AT(11-1)-171. 94p. (XDC-61-5-1)

Shielding Computer Program 15-2 employs both Monte Carlo and numerical methods to calculate the energy spectrum and angular distribution of gamma rays at a point detector due to single and multiple scattering in air from a monoenergetic, monodirectional point source. The program is coded for an IBM 704 (and 7090) computer with a fast memory capacity of 32,768 storage locations. It is a much improved and enlarged code over program 15-1 which it supersedes. (auth)

20150 (TID-12875) DIFFERENTIAL CROSS SECTIONS FOR THE $T(p,n)He^3$ REACTION. W. E. Wilson, R. L. Walter, and D. B. Fossan (Wisconsin. Univ., Madison). [1961]. 23p.

The zero-degree differential cross section of the $T(p,n)He^3$ reaction was measured with a recoil-proton counter telescope at about 0.5 Mev intervals from 5 to 13.5 Mev. Relative angular distributions of the neutrons from the reaction were also obtained at 0.5 Mev intervals from 5 to 13 Mev proton energy. Cross sections were obtained by normalization to the zero-degree telescope measurements. The distributions, when transformed to the center-of-mass system, were strongly peaked in the backward hemisphere. The center-of-mass distributions were fitted with a Legendre series expansion and the total reaction cross section obtained from the coefficients. (auth)

20151 (UCRL-6277) ELASTIC SCATTERING OF 24-MEV NEUTRONS BY Al, Fe, Sn, AND Bi (thesis). T. P. Stuart (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 1961. Contract W-7405-eng-48. 50p.

Elastic scattering of 24-Mev neutrons by Al, Fe, Sn, and Bi was measured for angles between 15 and 90° in 5° steps. Cylindrical scatterers were ½ mean free path or ¾ mean

free path in diameter as calculated using total cross sections. These cylinders were bombarded with neutrons from the T(dn)He^4 reaction, and the scattered neutrons were detected in a plastic scintillator. Biases were set at energies between 14 and 24 Mev. Corrections for effects due to scatterer size were carried out with a Monte Carlo code on the Univac and IBM 704. The corrected cross sections are in good agreement with optical-model calculations by Bjorklund and Fernbach. (auth)

20152 (UCRL-9497) NUCLEON AND NUCLEAR CROSS SECTIONS FOR POSITIVE PIONS AND PROTONS ABOVE 1.4 Bev/c (thesis). Michael J. Longo (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1961. Contract W-7405-eng-48. 77p.

Total (π^+,p) and (p,p) cross sections in the momentum range from 1.4 to 4.0 Bev/c are presented. These measurements, with an accuracy of ≈2%, were made at the Berkeley Bevatron using counter techniques. Pions were distinguished from protons by means of a gas-filled Cerenkov counter. The (π^+,p) total cross section was found to be almost constant above 2.0 Bev/c at a value near 29 mb. The (p,p) cross section decreased gradually from 47.5 mb to 41.7 mb over the momentum range covered. Transmission measurements of π^+-nucleus and p-nucleus cross sections in both good and poor geometry were made at 3.0 Bev/c. The results were compared with the predictions of the optical model and dispersion relations. In contrast to most previous work at high energies, an essentially exact solution of the wave equation for a potential well with a diffuse edge was used. The values of the imaginary part of the optical potential that best fit the experimental data were in good agreement with the predicted values. No strong conclusions regarding the real part of the potential are possible. Absorption and total elastic cross sections for Be, C, Al, and Cu are presented. The total elastic cross sections from this experiment disagree with Wikner's for π^--nucleus scattering. (auth)

20153 (UCRL-9511) ALPHA DECAY STUDIES IN THE FAMILIES OF THE LIGHT URANIUM ISOTOPES. Carl Phillip Ruiz (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1961. Contract W-7405-eng-48. 150p.

Using a 180° double-focusing alpha-particle spectrograph, an alpha-particle ionization chamber, and scintillation spectrometers, the alpha and gamma radiations of the U^{228} and U^{229} series, as well as U^{233}, Pa^{229}, and Ra^{222} are investigated. Decay schemes are presented in most cases and analyzed wherever possible in terms of the theoretical nuclear models. For the odd mass nuclides the Bohr-Mottelson model is used to interpret the decay schemes for $A \geq 225$; for $A < 225$ there is no obvious rotational pattern present. The spectroscopic data obtained for the even-even nuclides are in agreement with the previously existing systematics, and are discussed in terms of an axially asymmetric theory. The half-lives of U^{228}, Ra^{220}, Rn^{216}, Rn^{217}, and Rn^{218} are measured. Conventional counting techniques are used for the U^{228} half-life determination, while delayed coincidence counting and moving tape techniques are employed for the others. The data for the even-even nuclides are in good agreement with the systematics. (auth)

20154 (UCRL-9595) INVESTIGATION OF NUCLEAR REACTIONS BY RECOIL STUDIES OF RADIOACTIVE PRODUCTS. (thesis). John R. Morton, III (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1961. W-7405-eng-48. 112p.

The ranges and angular distributions of the recoiling residual nuclei from several nuclear reactions are studied to obtain information about the reaction mechanisms. The observed reactions are $Ra^{226}(\alpha,4n)Th^{226}$, $Pb^{208}(\alpha,2n)Po^{210}$, $Pr^{141}(C^{12},4n)Tb^{149}$, $Te^{130}(C^{12},5n)Ce^{137m}$, and $Pb^{207}(\alpha,n)Po^{210}$. The experimental angular distributions are compared with distributions calculated by a Monte Carlo method based upon the compound-nucleus and statistical models. The results from the $Ra^{226}(\alpha,4n)$ and $Pr^{141}(C^{12},4n)$ reactions agree with the simple theory. The $Te^{130}(C^{12},5n)$ data can be explained by formation of a compound nucleus which deexcites with enhanced probability for gamma emission. The $Pb^{208}(\alpha,2n)$ and $Pb^{207}(\alpha,n)$ experiments require substantial contributions from direct-interaction mechanisms. (auth)

20155 (UCRL-9610) THE ELASTIC SCATTERING OF 24-Mev DEUTERONS (thesis). Dennis G. Hoffman (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1960. 41p.

The angular distributions of the differential cross sections for the elastic scattering of 24-Mev deuterons were measured for the heavy elements, uranium, lead, gold, and tantalum. In general, the ratio of the differential cross section to the Rutherford cross section showed that the scattering is pure Rutherford scattering out to a critical angle. With increase in scattering angle beyond the critical angle the decrease of the ratio was exponential with a small diffraction-like pattern superimposed. A classical model, developed by Nishida in an attempt to determine the value of the critical angle, was considered, and shown not to be in agreement with experiment. A semi-classical model was developed which does explain the shift of the critical angle with energy and atomic number for the reported experimental data, ranging in energy from 11 to 24 Mev. The time-dependent perturbation theory was used to calculate the probability of electric dipole disintegration of the deuteron in the Coulomb field of the target nucleus. Comparison with experimental data indicated that contrary to the conclusions reached by Nishida and Yntema, the electric dipole breakup of the deuteron may play the major role in the observed deviation from pure Rutherford scattering. (auth)

20156 (AEC-tr-3971(p.512-49)) THE EFFECTIVE CROSS SECTIONS OF ATOMS FOR SPECTRAL EXCITATION. S. E. Frish. Translated from Uspekhi Fiz. Nauk, 61: No. 4, 461-90(1957).

The concept of effective cross sections of atoms for spectral excitation is discussed. To find the effective cross sections of collisions leading to atomic excitation from spectral line intensities it was necessary to find out what combination of processes determines the spectrum line intensity under the particular experimental conditions. The determination of effective cross sections by the electronic impact method is described. Experimental observation of cascade transitions and excitation of resonance lines are described. The significance of stepwise excitations is discussed. The possibility of spectroscopic determination of the effective cross sections for second-order collisions between two atoms was investigated. (M.C.G.)

20157 (AEC-tr-4602) PRODUCTION OF TRITIUM IN THORIUM BY 135 MEV PROTONS. M. Lefort, G. Simonoff, and X. Tarrago. Translated by M. S. Feldman from J. Phys. radium, 20: 959-62(Dec. 1959). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8090.

20158 (UCRL-Trans-227(L)) STUDY OF PARAMAGNETISM OF ATOMIC NUCLEI BY A METHOD OF A MAGNETIC SPIN RESONANCE. S. D. Gvozdover and A. A. Magazanik. Translated by S. Shewchuck from Zhur. Eksptl'. i Teoret. Fiz., 20: 705-21(1950). 25p.

A solution is given of a problem of nuclear induction in e form of an integral equation of Volterra type. Relation-ips are derived which by parameters of radio signals pearing during magnetic spin resonance permit determin-g how the vector of magnetization, conditioned by magnet-m of nuclei, varies with course of time. The dependence the shape of the radio signals on the amplitude of a high equency magnetic field was established. A case of peri-ic modulation of constant magnetic field is analyzed in tail and a new method of measurement of the time of ngitudinal relaxation is treated. The results of conducted periments are reported and compared with theory. Ex-riments confirmed the theoretical deductions. (auth)

0159 LEVEL SCHEME OF Au^{198} DETERMINED BY NALYSIS OF HIGH-PRECISION CAPTURE GAMMA-RAY EASUREMENTS. Bernard Hamermesh, J. E. Monahan, id Robert K. Smither (Argonne National Lab., Ill.). Ann. hys. (N.Y.), 13: 284-306(May 1961).

The gamma-ray spectrum resulting from the capture of ermal neutrons by Au^{197} is investigated by use of a bent-ystal spectrometer. A total of 122 lines corresponding to ansition energies less than 835 kev are observed. Their iergies are determined with an average precision of 1 rt in 5000. The method of generating a "most probable" vel scheme for Au^{198} from these measurements is de-ribed. A scheme containing 25 states is obtained that ows an unusual "fine structure" grouping of several vels. (auth)

0160 PRECISION MEASUREMENT OF GAMMA RAYS ROM β-DECAY IN Au^{198} AND Au^{199}. Bernard Hamermesh id Robert K. Smither (Argonne National Lab., Ill.). Ann. hys. (N.Y.), 13: 307(May 1961).

The γ rays following β decay of Au^{198} and Au^{199} are meas-ed with an error of 1 part in 1300. Two γ rays follow u^{198} decay, at 411.79 ± 0.03 kev and 674.32 ± 0.20 kev; two rays also follow Au^{199} decay, at 158.33 ± 0.02 kev and 08.12 ± 0.03 kev. (T.F.H.)

0161 39 MIN Au^{190}, 20 MIN Hg^{190}, AND 10 MIN Hg^{189}. . Andersson and R. Ringh (Gustaf Werner Inst. for Nuclear hemistry, Uppsala). Arkiv Fysik, 18: 385-8(1961). (In nglish)

The decay of conversion electron lines from mass sepa-ated sources was followed in a beta spectrometer, result-g in the following mass assignments: (38.8 ± 1.8) min u^{190}, (19.8 ± 0.6) min Hg^{190}, and (9.6 ± 0.4) min Hg^{189}. The alf life of Pt^{189} was measured to be (11.1 ± 0.4) hr. Ex-ited levels at 295 and 596 kev in Pt^{190} are indicated from ie Au^{190} decay. (auth)

0162 HIGH-ENERGY GAMMA-RAYS AND POSITRONS ROM 5.3 h Tl^{198}. R. K. Gupta, J. Svedberg, and G. Anders-on (Gustaf Werner Inst. for Nuclear Chemistry, Uppsala). rkiv Fysik, 18: 443-8(1961). (In English)

Scintillation spectrometer studies of mass-separated l^{198} sources have shown transitions of 2.01, 2.45 and 2.78 lev and probably others of 1.6, 1.8 and 2.2 Mev to be pres-nt in Hg^{198}. Results of gamma-gamma coincidence meas-rements form the basis for a preliminary discussion of ie level scheme. The end-point energy of the positron pectrum is determined as 2.44 ± 0.08 Mev. (auth)

0163 ALPHA ACTIVITIES AND MASS NUMBER AS-IGNMENTS OF LIGHT ASTATINE ISOTOPES PRODUCED Y HEAVY ION REACTIONS. W. Forsling, T. Alväger, . W. Holm, O. Melin, J. Uhler, and B. Åström (Nobel Inst. f Physics, Stockholm). Arkiv Fysik, 19: 83-98(1961). (In nglish)

In order to study neutron-deficient At isotopes, Au was bombarded by C and Ne ions in the Stockholm 225-cm cyclotron. Chemical isolations and mass separations were made and the α activities found were determined with respect to half lives and energies by use of ion chamber technique. The isotopes At^{202}, At^{203}, At^{204}, At^{205}, At^{206}, and At^{207} were studied. (auth)

20164 STUDY OF THE PRIMARY LEVELS OF O^{18} BY $F^{19}(n,d)O^{18}$ REACTIONS USING A TELESCOPE SELECTING THE DEUTERONS. Claude Bonnel and Philippe Lévy (Laboratoire de Synthèse Atomique et d'Optique Protonique, Ivry-sur-Seine, [France]). Compt. rend., 252: 2214-16 (Apr. 10, 1961). (In French)

Some results on the reaction $F^{19}(n,d)O^{18}$, produced by 14-Mev neutrons, obtained with a coincidence telescope which permits a differentiation of protons from deuterons, are presented. Four levels are shown. (tr-auth)

20165 STUDY OF THE DECAY OF MERCURY-192. Jerzy Jastrezbski and Pierrette Kilcher (Laboratoire de Physique Nucléaire, Orsay, France). Compt. rend., 252: 2220-2(Apr. 10, 1961). (In French)

The decay of Hg^{192}, isotopically separated, was studied. In the analysis of the energy of the conversion rays, 15 transitions were detected. The decay period was measured. The relative intensities of the γ rays were estimated by decomposition of the spectrum. The limits of the values for the half lives of the most important transitions are given. (tr-auth)

20166 QUADRUPOLE MOMENT OF THE FIRST EXCITED NUCLEAR STATE OF IRON-57. Anatole Abragam and Françoise Boutron. Compt. rend., 252: 2404-6(Apr. 17, 1961). (In French)

The sign and order of magnitude of the quadruople moment of the first excited state of Fe^{57} was determined from recent experimental results on the Mössbauer effect. (tr-auth)

20167 THE FISSION OF ANTIMONY BY FAST PROTONS. A. K. Lavrukhina, E. E. Rakovskii, Hêng-kung Su, and S. Khoinatskii (Vernadskii Inst. of Geo-chemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 826-9(Apr. 1, 1961). (In Russian)

A sample of metallic Sb, which had been purified a number of times by zone melting and had been shown to contain not more than 10^{-4} to 10^{-7}% of Mn, Cu, Zn, As, P, Cr and Ga impurities by neutron activation analysis, was irradiated with 660 mev protons. The spallation products were identified by radiochemical methods, and the yields of each were calculated. There is a great increase in the relative yield of neutron-deficient nuclei formed in fission of Sb as compared to the fission of heavier elements such as U, Th and Bi. Since most of the fission products of Sb were shielded isobars, it was possible to establish the type of distribution of the nuclear charge in the fission of Sb. The half-width for the yield distribution curve for various isobars represents 3 to 4 units of charge as compared to a smaller half-width of 2 to 3 units of charge for the fission of U, Th and Bi. If the energy of the incident protons is lowered to 220 Mev, the yield of asymmetrical fission products such as Cl^{38}, Cl^{39}, Mn^{56} and Co^{61} is decreased by a factor of 10, while the yield of V^{48}, which is a product of symmetrical fission, remains constant. Calculations show that the fission of Sb is accompanied by the emission of seven protons. The total fission cross-section of Sb for 660 mev protons is 0.25 mbarns. (TTT)

20168 POSITRON ANNIHILATION IN SULPHUR, SELENIUM AND SILICON. K. A. Baskova, B. S. Dzhelepov, and Z. A. Komissarova (Leningrad State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1001-3(Apr. 1961). (In Russian)

The angular distributions of annihilation γ-quanta are measured for crystalline and amorphic modifications of S, Se, and Si. (auth)

20169 NEUTRON EMISSION FROM STRONGLY EXCITED NUCLEI. A. S. Karamyan, G. A. Dorofeev, and D. S. Klochkov. Zhur. Eksptl'. i Teoret. Fiz., 40: 1004-6 (Apr. 1961). (In Russian)

The relative intensities and angular distributions of 10-, 15-, and 25-Mev effective energy neutrons produced by multicharged ions in the (C^{12}, xn, xp) and (O^{16}, xn, xp) reactions are investigated. The results are in satisfactory agreement with the predictions of the statistical model of nuclear reactions. (auth)

20170 α-DECAY OF THE Bi^{210m} ISOMER. L. I. Rusinov, Yu. N. Andreev, S. V. Golenetskii, M. I. Kislov, Yu. I. Filimonov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1007-15(Apr. 1961). (In Russian)

The long-lived α-active isomer Bi^{210m} has been measured. Lines with energies of 4930 ± 10 kev (60%), 4890 ± 10 kev (34%), 4590 ± 10 kev (5%), and 4480 ± 15 kev (~0.5%) have been detected in the α-spectrum. Gamma radiation from the daughter nucleus Tl^{206} has been detected and studied. Gamma rays with energies 262, 301, 340, and 610 kev have been found. The following coincidences were detected: $\alpha 4930-\gamma 262$, $\alpha 4890-\gamma 301$, $\alpha 4590-\gamma 610$, and $\alpha 4590-\gamma 340$ kev. The γ-transition multipolarities were determined from the conversion electron spectrum and found to be E2 for 262 kev and M1 for 301 kev. The measured lifetimes of the Tl^{206} levels are $\tau(262\text{ kev}) = 1.7 \cdot 10^{-9}$ sec, $\tau(301\text{ kev}) = 4.6 \cdot 10^{-9}$ sec. A decay scheme for Bi^{210m} is constructed on basis of the experimental data. It is shown that RaE is the ground state of Bi^{210} and the long-lived Bi^{210m} is its excited state with a partial half-life relative to the isomer transition of $\sim 5 \cdot 10^{10}$ years. The experimental data are compared with the theoretical calculations of the energy states of the Tl^{206} and Bi^{210} nuclei. (auth)

20171 RESONANCE SCATTERING OF γ-RAYS ON Te^{124} NUCLEI. A. F. Akkerman, D. K. Kaipov, and Yu. K. Shubnyi (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1031-2 (Apr. 1961). (In Russian)

The lifetime of the 608-kev excited level of the Te^{124} nucleus is determined on basis of the experimental value of the γ-quantum resonance scattering cross section. The value obtained is compared with the predictions of the single particle model. (auth)

20172 THE MASS OF THE Pu^{240} ISOTOPE. R. A. Demirkhanov and V. V. Dorokhov. Zhur. Eksptl'. i Teoret. Fiz., 40: 1033-4(Apr. 1961). (In Russian)

Exact mass spectrographic determinations of the mass of the Pu^{240} isotope are made. (auth)

20173 SOME ISOTOPIC RELATIONS FOR REACTIONS OF THE TYPE $\pi N \rightarrow \pi\pi N$. V. N. Strel'tsov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1140-2(Apr. 1961). (In Russian)

An analysis of the experimental data for reactions of the type $\pi N \rightarrow \pi\pi N$ is carried out with help of the isotopic relations from the standpoint of resonance $\pi\pi$-interaction. (auth)

20174 SCATTERING OF LOW ENERGY PHOTONS ON A SPIN 1/2 SYSTEM. V. A. Petrun'kin (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1148-54(Apr. 1961). (In Russian)

An expression for the scattering cross section of low energy photons on a spin $\frac{1}{2}$ system is obtained in the local theory with an accuracy to terms quadratic in frequency. Besides the constants e, M, and λ (respectively the charge mass and anomalous moment of the system) three other parameters, α, β, and $\langle r_e^2 \rangle$ (the electric and magnetic polarizabilities and mean square radius of the charge distribution of the system) also enter the cross section formula. (auth)

20175 ON POLARIZATION OF RECOMBINATION RADIATION. B. A. Lysov, L. P. Belova, L. I. Korovina (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1160-5(Apr. 1961). (In Russian)

Polarization of radiation following the capture of a relativistic electron into the K-shell is considered. Partial elliptical polarization is shown to take place in the case. The expression for intensity of the unpolarized part of radiations is given. The electron spin contribution is discussed. The calculations are performed in lowest order in αZ. (auth)

20176 DYNAMIC EFFECT OF THE NUCLEAR VOLUME IN CONVERSION M1-TRANSITIONS IN EVEN-EVEN NUCLEI IN THE NONAXIAL ROTATOR MODEL AND IN THE VIBRATIONAL MODEL OF THE NUCLEUS. D. P. Grechukhin. Zhur. Eksptl'. i Teoret. Fiz., 40: 1185-9 (Apr. 1961). (In Russian)

The corrections to the internal conversion coefficient for a M1 nuclear transition which appears when the potential produced by the intranuclear electron transition current is taken into account are estimated for the transitions of K, LI- and LII-electrons to the $s_{1/2}$ and $p_{1/2}$ states of the continuous spectrum. The calculations are performed according to the harmonic vibrational model of the nucleus and the nonaxial rotator model (Davydov-Filippov model). (auth)

20177 CALCULATION OF THE ELASTIC SCATTERING CROSS SECTION FOR 5.45 Mev PROTONS ACCORDING TO OPTICAL MODEL OF THE NUCLEUS. R. A. Vanetsian, A. P. Klyucharev, G. F. Timoshevskii, and E. D. Fedchenko. Zhur. Eksptl'. i Teoret. Fiz., 40: 1199-1202(Apr. 1961). (In Russian)

The differential cross sections for elastic scattering of 5.45 Mev protons on separated isotopes $Cr^{52,53}$, Co^{59}, $Ni^{58,60,62,64}$, $Zn^{64,68}$, Cu^{65} have been calculated by employing a complex potential in the optical model. The real part of the potential was chosen in the Saxon form and the imaginary part in the Gaussian form. Satisfactory agreement with the experimental data has been obtained for isotopes whose (p,n) threshold is below the energy of the scattered protons. It has been impossible to make the experimental data consistent with optical model calculations for isotopes whose cross sections strongly increase at large angles. (auth)

20178 POLARIZATION DUE TO SCATTERING OF SLOW NEUTRONS IN FERROMAGNETIC SUBSTANCES. S. V. Maleev (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1224-7(Apr. 1961). (In Russian)

An expression is obtained for the polarization of slow neutrons scattered in ferromagnetic substances. The polarization vector is shown to consist of two mutually perpendicular components, one of which is due to interference between nuclear and magnetic scattering and the other to inelastic scattering involving a spin reversal of the neutron. (auth)

20179 THE NEUTRON AS A PROBE OF NUCLEAR MATTER. J. L. Fowler (Oak Ridge National Lab., Tenn.). J. Tenn. Acad. Sci., 36: No. 2, 109-21(Apr. 1961).

The uses of the neutron in nuclear spectroscopy are reewed. The scattering of neutrons by doubly magic O^{16} is udied in terms of phase shifts and potential models. .F.H.)

0180 THE EFFECT OF PAIR CORRELATION ON HE MOMENT OF INERTIA AND THE COLLECTIVE YROMAGNETIC RATIO OF DEFORMED NUCLEI. S. G. lsson and O. Prior. Kgl. Danske Videnskab. Selskab, at.-fys. Medd., 32: No. 16, 1-61(1961). (In English) The moment of inertia and the collective gyromagnetic tio of even-even nuclei are calculated on the basis of ave functions that take a pairing interaction into account rough the quasi-particle formalism. The results obtained eoretically are found to be in reasonable agreement with periments. The strength of the characteristic pair-rrelation matrix element employed is estimated on the sis of data on odd-even mass differences. The depend-ce of the calculated results on the central-field parame-rs, such as the eccentricity and the single-particle en-gy scale, is discussed. Other possible effects relevant the odd-even mass difference and the experimentally served energy gap are also surveyed. (auth)

0181 MERCURY-206: A NEW NATURAL RADIONUCLIDE. M. Nurmia, P. Kauranen, M. Karras, A. Siivola, Isola, G. Graeffe, and A. Lyyjynen (Univ. of Helsinki, nland). Nature, 190: 427-8(Apr. 29, 1961). The half life of Hg^{206} was determined as 7.5 ± 1 min. The rmation and properties of Hg^{206} are discussed. (C.H.)

0182 NONEXISTENCE OF A 9.0-Mev LEVEL IN C^{12}. E. Alburger and D. H. Wilkinson (Brookhaven National ab., Upton, N. Y.). Phys. Rev., 122: 1508-9(June 1, 61). (BNL-5154) An energy level in C^{12} at 9.0 Mev is reported as a re-lt of (p,γ,γ) triple coincidence measurements on the $^0(He^3,p)C^{12}$ reaction at 2.2 Mev. This reaction is rein-stigated in a similar experimental arrangement by using ternately Pilot-B, CsI and NaI scintillators for detection the protons. Only the Pilot-B, which is used in the pre-ous work, exhibits the proton group corresponding to a) Mev level in C^{12}. The triple coincidence effect in this se is actually due to the intense ~17 Mev protons in the $^0(He^3,p)C^{12}$ reaction leading to the 4.43 Mev first excited ate of C^{12} which upon entering the scintillator can inelas-ally scatter from carbon and produce secondary gamma diation of 4.43 Mev. The net energy deposited in the intillator has the appearance of a proton group to a 9.0 ev level in C^{12} in triple coincidence with two 4.43 Mev mma rays. The magnitude of the effect is calculated om published cross sections for inelastic scattering and agrees with the apparent population intensity of the non-istent 9.0 Mev level. (auth)

0183 GAMMA RADIATION FROM LOW LEVELS OF ^{27}. R. D. Bent and W. W. Eidson (Indiana Univ., Bloom-gton). Phys. Rev., 122: 1514-17(June 1, 1961). The $Al^{27}(\alpha,\alpha'\gamma)$ reaction was investigated by using parti-e-gamma coincidence techniques and a 22 Mev alpha-rticle beam. A 0.79 ± 0.03 Mev gamma-ray transition tween the 3.0 and 2.21 Mev states of Al^{27} was observed. is result, together with other data, suggested that the 3.0 d 2.21 Mev states were the $^9/_2{}^+$ and $^7/_2{}^+$ members of a = $^5/_2$ rotational band. (auth)

0184 POSSIBLE PARITY AND TIME-REVERSAL XPERIMENTS USING THE MÖSSBAUER EFFECT. Morita (Columbia Univ., New York). Phys. Rev., 122: 25-6(June 1, 1961). In the successive transition of the beta and gamma decays, the excited and ground states of the daughter nucleus are effectively polarized, when the satellites of the Mössbauer effect are separately observed. Using this nuclear polarization, various experiments are proposed to detect parity nonconservation and time-reversal invariance in beta decay. These experiments involve the measurement of the coincidence counting rate of beta rays and satellites of the Mössbauer effect. The resulting improvement in accuracy will make possible, for example, the precision measurement of the asymmetry of beta-ray angular distributions. (auth)

20185 NEUTRON GROUPS FROM K(α,n)Sc. A. M. Smith and F. E. Steigert (Yale Univ., New Haven). Phys. Rev., 122: 1527-30(June 1, 1961).

Neutron groups resulting from the alpha-particle bombardment of separated isotopes of potassium were observed. Ground-state Q values of −3.42 ± 0.06 Mev for $K^{41}(\alpha,n)Sc^{44}$ and −7.16 ± 0.06 Mev for $K^{39}(\alpha,n)Sc^{42}$ were obtained. A large number of excited states or groupings of states were also observed. The presence of chlorine in one of the targets permitted measurement of the $Cl^{37}(\alpha,n)K^{40}$ reaction as well. A ground-state Q value of −3.86 ± 0.06 Mev was obtained. A tentative value of −5.89 ± 0.06 Mev was given for the $Cl^{35}(\alpha,n)K^{38}$ ground state. (auth)

20186 CORE EXCITATIONS IN NONDEFORMED, ODD-A NUCLEI. A. de-Shalit (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 122: 1530-6(June 1, 1961).

The possibility of describing some excited states of odd-A nuclei in terms of excitations of the even-even core is investigated. No assumption is made on the nature of the core excitation, but certain relations involving electromagnetic transitions and moments are deduced. These seem to fit well some data available on Ag^{107}, Ag^{109}, Au^{197}, Hg^{199}, Tl^{203}, and Tl^{205}. More experimental data are required to test the validity of this model in other cases. (auth)

20187 $Ce^{140}(d,p)Ce^{141}$ REACTION. G. B. Holm and H. J. Martin, Jr. (Indiana Univ., Bloomington). Phys. Rev., 122: 1537-41(June 1, 1961).

Eight proton energy groups were observed, leading to levels in Ce^{141} at 0, 0.65, 1.12, 1.35, 1.47, 1.77, 2.15, and 2.41 Mev. Angular distributions and relative cross sections were used to make the following assignments: $^7/_2-$ for the ground state, $^3/_2-$ for the 0.65 Mev state, $^3/_2-$ for the 1.12 Mev state; $^5/_2-$ for the 1.77 Mev state, and $^1/_2-$ for the 2.41 Mev state. (auth)

20188 MECHANISM OF FISSION OF HEAVY NUCLEI. Peter Fong (Utica Coll. of Syracuse Univ., Utica, N. Y.). Phys. Rev., 122: 1542(June 1, 1961).

The validity of the Vladimirskii mechanism of fission is questioned. In this mechanism, the individual nucleons with large component of angular momentum in the direction of the symmetry axis give rise to instability against asymmetric deformation, and thus lead to an asymmetric saddle point. (auth)

20189 STATISTICAL THEORY OF NUCLEAR FISSION AND PROMPT NEUTRON DISTRIBUTION. Peter Fong (Utica Coll. of Syracuse Univ., Utica, N. Y.). Phys. Rev., 122: 1543-4(June 1, 1961).

It is shown that the statistical theory of nuclear fission is consistent with experimental results of prompt neutron distribution in fission, if the existence of some constraint is assumed in the process of approaching equilibrium. This constraint is necessary to control the partition of excitation energy between the two fragments. (auth)

20190 NUCLEAR MODELS AND NUCLEAR FISSION. Peter Fong (Utica Coll. of Syracuse Univ., Utica, N. Y.). Phys. Rev., 122: 1545-6(June 1, 1961).

The hindrance to spontaneous fission by the odd nucleon in the fissioning nucleus may be explained as due to the pairing energy of the odd nucleon at the saddle-point deformation. (auth)

20191 DECAY OF I^{134}. Noah R. Johnson, E. Eichler, G. D. O'Kelley, J. W. Chase, and J. T. Wasson (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 1546-58(June 1, 1961).

The decay properties of 53 min I^{134} were investigated with scintillation techniques. Energies (and intensities) of the gamma rays determined from the single-crystal and coincidence studies were 0.135 (3.2), 0.18, 0.23, 0.27, 0.32, 0.39 (7.2), 0.41 (0.6), 0.43 (2.9), 0.51 (0.9), 0.54 (8.4), 0.61 (19), 0.69 (7.3), 0.75 (1.3), 0.77 (6.0), 0.848 (100), 0.864 (4.6), 0.890 (74), 0.96 (2.0), 1.00 (4.7), 1.07 (18), 1.15 (10), 1.28 (1.4), 1.34 (1.5), 1.46 (3.7), 1.49 (1.0), 1.62 (4.9), and 1.79 (4.9) Mev. There were multiple gamma rays near energies of 0.89 and 1.07 Mev. The single-crystal spectra were corrected experimentally for gamma-ray summing. Gamma coincidence spectra were measured by gating at energies of 0.135, 0.41, 0.61, 0.85, 0.89, 1.00, 1.07, 1.15, 1.46, 1.62, and 1.79 Mev in the gamma-ray spectrum. Beta-ray spectra were measured in coincidence with gamma rays at 0.85, 1.00, 1.07, 1.15, 1.46, 1.62, and 1.79 Mev. These measurements and the single-crystal data disclosed beta rays with end-point energies of 2.41, 2.21, 1.68, 1.49, 1.25, and 1.05 Mev. In a three-crystal "beta-gamma-gamma" experiment the 2.41-Mev beta-ray group was shown to populate a level in Xe^{134} at 1.74 Mev; therefore, the energy difference between the ground states of I^{134} and Xe^{134} was 4.15 ± 0.06 Mev. A decay scheme was proposed with energy levels (and spins) in Xe^{134} at 0.85 (2+), 1.62 (2+), 1.74 (4+), 1.92, 2.34, 2.43, 2.48, 2.64, 2.88, 3.11, 3.30, and 3.41 Mev. A collective nature of the low-lying levels was suggested in that the 1.62 and 1.74 Mev states appeared to be members of a "vibrational" doublet at about twice the energy of the first excited state. The half-life of I^{134} was redetermined as 52.8 ± 0.3 min (auth)

20192 NEUTRON-DEFICIENT NUCLIDES OF HAFNIUM AND LUTETIUM. Erich R. Merz and Albert A. Caretto, Jr. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 122: 1558-63(June 1, 1961).

Neutron-deficient nuclides of lutetium and hafnium were produced by bombarding lutetium oxide with 300 to 400 Mev protons. The positron spectra of the different nuclides were measured with an anthracene crystal detector and a 256-channel pulse height analyzer. Gamma radiation was also observed for Lu^{168}, Lu^{169}, Lu^{170}, Hf^{168}, and Hf^{169} by means of a NaI crystal detector and the pulse height analyzer. The half lives and maximum positron energies observed were: Lu^{168}, $T_{½}$ = 7.0 min, E_{β^+} = (1.20 ± 0.05) Mev; Lu^{169}, $T_{½}$ = 1.5 days; Lu^{170}, $T_{½}$ = 1.9 days, E_{β^+} = (1.8 ± 0.1) Mev; Hf^{168}, $T_{½}$ = 22 min, E_{β^+} = (1.7 ± 0.1) Mev; Hf^{169}, $T_{½}$ = 1.5 hr; Hf^{170}, $T_{½}$ = 9 hr. (auth)

20193 NUCLEAR SPECTROSCOPY OF Ta^{181}. Arthur H. Muir, Jr. and F. Boehm (California Inst. of Tech., Pasadena). Phys. Rev., 122: 1564-73(June 1, 1961).

The nuclear levels of Ta^{181} were investigated by a study of the β decay of Hf^{181} and the electron capture decay of W^{181}. Evidence for weak M-shell conversion lines of an ~6 kev transition in the Hf^{181} was found with a β spectrometer. An investigation of the W^{181} decay with this instrument revealed strong M-shell conversion lines corresponding to a 6.25 ± 0.3 kev transition. With the aid of additional evidence, the conclusion is made that the 476 kev transition in the Hf^{181} decay occurs between the 482 kev level and a new level at 6 kev. Using an argon proportional counter, a 6 kev γ ray was also found in the W^{181} decay. The conversion coefficient of this transition was determined to be $\alpha_T = 44 \pm 7$. This conversion coefficient and the M-subshell conversion ratios indicated that the 6 kev transition was of E1 multipolarity. The 6 kev level was assigned as the 9/2– [514] Nilsson intrinsic state. It was also concluded that the 152 kev transition in the W^{181} decay occurs between a new 11/2– (K = 9/2–) rotational level at 158 kev and the 6 kev level. From a measurement of the tantalum L/K x-ray intensity ratio, the W^{181} decay energy was found to be 176^{+44}_{-22} kev. The branchings of this decay to the various Ta^{181} levels are as follows: 158 kev (0.11%), 136 kev (0.067%), 6.25 kev (~35%), and ground state (~65%). All findings and proposals are consistent with predictions of the unified model of the nucleus. (auth)

20194 NUCLEAR MOMENTS AND ISOTOPE SHIFTS OF Tl^{199}, Tl^{200}, Tl^{201}, AND Tl^{204}—ISOTOPE SHIFTS IN ODD-ODD NUCLEI. R. J. Hull and H. H. Stroke (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 122: 1574-5(June 1, 1961).

The hyperfine-structure separations and isotope shifts of several radioactive isotopes of thallium are measured by optical spectroscopic techniques. The results are: $\mu^{199} = 1.57$ nm; $\mu^{201} = 1.58$ nm; and both $|\mu^{200}|$ and $|\mu^{202}| \leq 0.15$ nm. The isotope-shift measurements, which include the first data of this kind obtained for heavy odd-odd nuclei, permit a comparison of the relative isotope shifts for isotones in mercury and thallium. A marked similarity in the shifts is observed. (auth)

20195 BETA DECAY OF NATURALLY RADIOACTIVE In^{115}. G. B. Beard (Wayne State Univ., Detroit) and W. H. Kelly. Phys. Rev., 122: 1576-9(June 1, 1961).

A liquid scintillator loaded with indium is used to study the fourth-forbidden beta decay of In^{115}. Specific activity measurements yield a half-life of $(6.9 \pm 1.5) \times 10^{14}$ years. A crude beta spectrum is obtained. Linear extrapolation of the Fermi-Kurie plot gives an end-point energy of 625 ± 70 kev. (auth)

20196 INVESTIGATIONS OF THE REACTION $Cl^{35}(n,\gamma\gamma')Cl^{36}$. James E. Draper and Allan A. Fleischer (Yale Univ., New Haven). Phys. Rev., 122: 1585-9(June 1, 1961).

Two-step gamma-ray cascades to the ground state of Cl^{36} following thermal neutron capture by Cl^{35} are investigated with the sum-coincidence apparatus. The result is the product I_1b_2 of the intensity I_1 of the initial transition and the branching factor b_2 of the intermediate state to the ground state. The quantity b_2 is separately deduced from auxiliary information about I_1. The lower-energy members of the stronger cascades occur at 0.79, 1.16, 1.60, 1.96, and 2.87 Mev with respective values of I_1b_2 of 8.2, 11.6, 2.9, 12.1, and 5.1 per 100 neutrons captured. Weaker cascades appear at 2.2, 2.48, 2.6, 2.68, and 3.05 Mev. Cascades appearing between 3.3 and 4.3 Mev have $I_1b_2 \leq 0.5\%$. The b_2 following the strongest of all initial transitions, viz 6.11 Mev, is only ≤0.02. Approximately 46% of all neutron captured produce two-step cascades in Cl^{36}. (auth)

20197 INTRINSIC EXCITED STATES IN Hf^{178} POPULATED BY THE ALLOWED DECAY OF 9.3-min Ta^{178}. C. J. Gallagher, Jr., H. L. Nielsen, and O. B. Nielsen (Univ. of Copenhagen). Phys. Rev., 122: 1590-9(June 1, 1961).

The levels in Hf^{178} populated by the allowed positron and electron capture decays of 9.3 min Ta^{178} are investigated with a six-gap spectrometer. Conversion-electron spec-

rum and beta-gamma coincidence measurements establish the spin and parities of levels in Hf^{178} with energies of 93(2+), 307(4+), 1197(0+), 1277((2+)), 1430((1+)), 1440(0+), 1483(2+) kev, and possibly a level at 1550 kev. (Double parentheses indicate that the spin is not definitely established.) Intrinsic configuration assignments for the excited states are discussed in terms of theoretical developments. The half life of the 93 kev level is found to be $(1.25 \pm 0.08) \times 10^{-9}$ sec. The β^+/K capture ratio measured for the allowed decay to ground is within experimental error of theory. Reduced E0/E2 transition probability ratios for the transitions depopulating the 1197 and 1440 kev 0+ levels are calculated from the observed K-conversion line intensities of the E0 and E2 transitions depopulating the levels. (auth)

20198 DIRECT NUCLEON-NUCLEON COLLISIONS INSIDE THE NUCLEUS ACCORDING TO THE IMPULSE APPROXIMATION. Lester Winsberg and Thomas P. Clements (Univ. of California, Berkeley). Phys. Rev., 122: 1623-30(June 1, 1961).

To aid in the interpretation of nuclear reactions, the collisions between an incident nucleon and nucleons in a Fermi gas are analyzed by means of the impulse approximation. The treatment is based on information from nucleon-nucleon scattering experiments. Collisions inside a nucleus are considered to be the same as those in the unbound state at the same center-of-mass energy, except for the effect of the Pauli exclusion principle. The effective elastic and inelastic cross section, (σ), between like and unlike nucleons is computed for incident energies from 10 Mev to 6 Bev at several values of the Fermi energy. The properties of the struck nucleons in allowed collisions are also calculated. This information may prove useful in interpreting some recoil experiments. Analytical expressions for (σ) and quantities related to the struck nucleon are given for elastic collisions in which the scattering is isotropic and the free-particle cross sections are either constant or vary inversely as the bombarding energy. (auth)

20199 NUCLEAR DEFORMATION AND NUCLEAR FORCE. [Part] I. Sinobu Nagata (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 35-50(Jan. 1961).

The magnitude of nuclear deformation is determined by the variational method in the case of the rotational light nuclei. The Hamiltonian used is essentially the same as that of Brueckner's shell model space, where the reaction matrix is calculated from the Gammel-Thaler potential. The deformed potential model wave function is taken as a trial wave function, where the deformation parameter and the inter-nucleon distance are taken as variational parameters. The central force gives the equilibrium deformation of the same order as the experimental value for some configurations in case of Mg^{24}. The discussion is also given. (auth)

20200 NUCLEAR DEFORMATION AND NUCLEAR FORCE. [Part] II. Kiyomi Ikeda, Sinobu Nagata, and Kenjiro Takada (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 51-63(Jan. 1961).

A method is given to correlate nuclear deformation to nuclear force. A calculation is carried out for the tensor and spin-orbit part of the reaction matrix in the case of Mg^{24}. The following conclusions are obtained: the nuclear deformation is $\delta_{eq} = 0.35$, which is reasonable in comparison with experiment. About 150% of the value of the spin-orbit splitting comes from the spin-orbit part of the reaction matrix, and the splitting lowers the energy of the configuration of the ground state that has the stable nuclear deformation. The tensor interaction among the particles in the open shell has only small contribution to the deformation. Nilsson's model is self-consistent. (auth)

20201 NUCLEAR FORCES IN THE MOMENTUM SPACE. Junko Goto and Shigeru Machida (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 64-82(Jan. 1961).

Several fundamental problems concerning a two-nucleon system in the momentum space are discussed. Solutions to these problems should be useful for treating the two-nucleon problem completely nonstatically, i.e., without making use of the expansion in terms of the inverse of the mass of the nucleon. General forms for a two-nucleon potential in the momentum space are derived. The integral equations that are the Fourier transform of the Schrödinger equation, along with solutions of these equations are briefly discussed. Formulas for matrix elements of the most general types of potentials are evaluated and are applied to the nonstatic one-pion-exchange potential. (auth)

20202 SINGLE PION PRODUCTION PROCESS IN PION-NUCLEON COLLISION AND THE SAKATA MODEL. Shoji Sawada (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto) 25: 83-101(Jan. 1961).

Based on the Sakata model, a model is proposed for the single pion production process in π-N collision. It is pointed out that analyses of sub-Bev single pion production phenomena give information about the level scheme of the Sakata model. As a first step of the investigation of this model an analysis of the single pion production process in π^+-p collision at 500 Mev is made. The model predicts the contribution of the I = 2 boson isobar as well as the I = 3/2 fermion isobar for this process. Such a prediction is consistent with the experimental branching ratio $(\pi^+ + p \rightarrow \pi^+ + \pi^0 + p)/(\pi^+ + p \rightarrow \pi^+ + \pi^+ + n) = 1.5$. The energy and angular distribution of the pion and nucleon are useful for obtaining information about the I = 2 boson isobar and I = 3/2 fermion isobar from this process. (auth)

20203 SYMMETRY IN SAKATA'S MODEL AND WEAK INTERACTIONS. [Part] II. Mineo Ikeda (Hiroshima Univ., Takehara, Japan), Yoshihiko Miyachi, and Shuzo Ogawa. Progr. Theoret. Phys. (Kyoto), 25: 121-52(Jan. 1961).

A scheme is studied for non-leptonic decays of hyperons and K-mesons, in the full symmetry theory of Sakata's composite model. It is shown that the relations between various decay amplitudes are independent of particular configurations assigned to the particles which participate in the reactions. The K-3π decay is studied to show that the decay scheme is workable. Anomalous decay modes are discussed in which there appear one or more $\pi^{0\prime}$ or $\pi^{0\prime\prime}$ in place of π^0. (auth)

20204 REMARKS ON EDEN'S "PROOF" OF THE MANDELSTAM REPRESENTATION. Noboru Nakanishi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 155(Jan. 1961).

A counter-example is offered to Eden's proof of the Mandelstam representation in every order of perturbation theory. The proof assumes the absence of anomalous thresholds, the presence of a complex neighborhood on the real axis where the scattering amplitude is analytic with respect to all energy variables, and that a single dispersion relation holds for each energy variable. It is noted that this counter-example offers a serious objection to the Mandelstam representation. (T.F.H.)

20205 NOTE ON THE PION PROPAGATOR IN THE COMPOSITE THEORY. Takeshi Kanki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 156-8(Jan. 1961).

The pion is assumed to be a composite particle, composed of nucleons N and antinucleons. N-N interactions are considered to be fundamental, in the sense that the dissociated pion contribution probably dominates the as-

sociated pion contribution in the nucleon core region. The pion propagator may be expressed as a function of the N-N interaction higher-order terms. It is shown that the effect of the pion propagator on N-N interactions is appreciable, even at very small N-N separations; the n-p interaction is given as an example. (T.F.H.)

20206 ON THE SMALL-ANGLE SCATTERING OF HIGH-ENERGY PROTONS. Shoroku Ohnuma (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 158-9(Jan. 1961).

The scattering of protons by nuclei is considered at 90, 156, and 310 Mev. The ratio P/θ (polarization/scattering angle) is calculated from nucleon-nucleon (N-N) scattering phase shifts and compared with p-C scattering data. It is noted that contributions due to small N-N phase shifts are appreciable. In the T = 0 state, for example, these small phase shifts can increase P/θ from 7.4 to 8.6%/degree. The importance of these phase shifts is discussed for the T = 1 state and for n-p scattering. (T.F.H.)

20207 RADIOCHEMICAL INVESTIGATION OF URANIUM FISSION BY 660 MEV PROTONS. A. K. Lavrukhima and S. S. Rodin. Radiokhimiya, 2: 83-93(1960). (In Russian)

Radiochemical studies of products of uranium fission by 660-Mev protons indicated a pattern of residual nuclear products with regularities in their formation. The total cross section for proton fission is 0.4×10^{-24} cm^2; the yield of neutron saturated isotopes is comparatively high. The isotopes of maximum yield are located in the proximity of the nuclear stability line. The magnitude $\Sigma n/\Sigma f = 2.3$ indicates considerable proton emission during U spallation; probably contributed by product fission and by a large fragmentation cross section. The influence of the fission process on spallation product yield is analyzed. (R.V.J.)

20208 DETERMINATION OF THE CROSS SECTIONS OF SOME NUCLEAR REACTIONS WITH 14-MEV NEUTRONS USING THE ACTIVATION METHOD. H. Pollehn and H. Neuert (Physikalische Staatsinstitut, Hamburg). Z. Naturforsch., 16a: 227-31(Mar. 1961). (In German)

A series of cross sections of (n,p), (n,α), (n,2n), and (n,He^3) reactions in Fe, Al, Cu, Ce, and Cs were measured with 14-Mev neutrons. The cross sections were determined from the radioactivity by counting the γ beams registered with a NaI(Tl) drilled crystal and from the calculated susceptibility of the crystal. (tr-auth)

20209 PRODUCTION OF TRITIUM AND RARE GAS ISOTOPES IN THE IRRADIATION OF Fe AND Cu WITH 25-BEV PROTONS. K. Goebel (CERN, Geneva) and J. Zähringer. Z. Naturforsch., 16a: 231-6(Mar. 1961). (In German)

Production cross sections for tritium and the rare gases were measured in Fe and Cu at 25 Bev proton energy. The results do not show any essential variation compared to results at lower energies. The He^3/T ratio, measured in the same stack of targets, is about 1.2. The cross sections for He and T are approximately the same as at 3 Bev. Also the yield for argon isotopes is the same as measured at lower energies. (auth)

20210 THE DECAY OF W^{183m}. W.-D. Schmidt-Ott, K.-W. Hoffmann, I. Y. Krause, and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik, 162: 329-36(1961). (In German)

W^{183m} was produced by the reaction $W^{182}(n,\gamma)W^{183m}$. The half life was remeasured yielding a value of (5.1 ± 0.2) sec. With the aid of scintillation spectrometers four γ lines could be detected: two lines at about 100 kev, one at (161 ± 3) kev, and one at (211 ± 4) kev. A new technique was used to obtain the energy of the isomeric state. The total transition energy of this state was measured by summing up all possible cascade transitions of γ rays and conversion electrons with a source between two halves of a CsI crystal. The results are compared with the level scheme of W^{183} as measured by Murray et al. in the β decay of Ta^{183}. A decay scheme of W^{183m} is presented with the isomeric state at (310 ± 4) kev and three known lower energy levels of W^{183} at 207, 99, and 46 kev. The main branch of the isomeric decay leads to the 207 kev level most probably by an M2 transition. (auth)

20211 RATIO OF THE DIFFERENTIAL (e,$\mathcal{N}$) TO THE TOTAL (γ,$\mathcal{N}$) CROSS SECTION. Rudolf Rodenberg (Universität, Tübingen, Ger.). Z. Physik, 162: 347-57(1961). (In German)

The ratio of the electron differential scattering cross section to the total gamma scattering cross section is derived with the use of the relativistic Coulomb eigenfunctions for the continuous spectrum. For electric and magnetic dipole transitions the Born approximation, the Coulomb correction, the effect of screening, and the effect of finite nuclear size are calculated. In this angular distribution there should be no interference of electron waves scattered by different multipoles, where the inelastically scattered electrons are detected. Numerical calculations were done for nuclei with Z = 6, 29, and 82 and scattering angles ϑ = 1°, 132°, 160°, and 180° of the electron. The result of this theory is compared with the experiments of W. C. Barber et al. (auth)

20212 ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED 14.5 Mev NEUTRONS. V. I. Strizhak, V. V. Bobyr, and L. Ya. Grona (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 725-8(Mar. 1961). (In Russian)

The differential cross sections for elastic scattering of 14.5-Mev neutrons on silver, mercury and bismuth are measured. Neutrons from the T(d,n) α reaction were scattered by spherical scatterers and recorded in coincidence with the attendant α-particles using a pulse height-time analyzer with a resolving time of $5 \cdot 10^{-9}$ sec. The experimental differential cross sections are compared with the values computed on basis of the optical nuclear model. (auth)

20213 INVESTIGATION OF (n,2n) REACTIONS LEADING TO THE FORMATION OF ISOMERS. V. L. Glagolev, P. A. Yampol'skii (Inst. of Chemical Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 743-8 (Mar. 1961). (In Russian)

Data are presented on the cross sections for (n, 2n) reactions involving 14.7-Mev neutrons and leading to the formation of the isomers Y^{88m} ($\sigma_m > 0.4$ barns), Nb^{92g} (σ_g = 0.53 ± 0.06 barns), Pb^{207m} (σ_m = 1.7 ± 0.3 barns), Bi^{208m} (σ_m = 0.66 ± 0.12 barns). The cross section for the reaction with lead is evaluated in the assumption that the isomer is produced only in the reaction Pb^{208} (n, 2n) Pb^{207m}. The corresponding value is compared with that computed by strong interaction theory and under the assumption of a two-stage mechanism of neutron evaporation in the (n,2n) reaction. The Pb^{207} level scheme which agrees with the shell model is employed in the calculations. The relative probabilities for various types of transitions were estimated from the relation between the lifetime of a nucleus in the excited state and the transition energy. The results of the measurements and the calculations are in good agreement. The radiation characteristics of the following isomers are reported: Nb^{92g} ($T_{1/2}$ = 10.0 ± 0.3 d, E_γ = 0.94 ± 0.01 Mev), Bi^{208m} ($T_{1/2}$ = 2.6 ± 0.1 msec, E_γ = 0.50 ± 0.02 Mev, E_γ = 0.88 ± 0.02 Mev) and Na^{24m} ($T_{1/2}$ = 18.3 ± 0.6 msec). (auth)

20214 THE g-FACTORS FOR COLLECTIVE AND INTERNAL MOTION IN Tb^{159} AND Yb^{173} NUCLEI. E. E. Berlovich, M. P. Bonits, and M. K. Nikitin (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 749-51(Mar. 1961). (In Russian)

The probabilities for dipole transitions from first excited states in Tb^{159} and Yb^{173} nuclei have been measured with a multi-channel time analyzer. The gyromagnetic factors calculated on basis of the generalized model are compared with the results of experiments on coulomb excitation. The experimental results show that the g-factors for collective motion are close to those estimated on the basis of the generalized model according to the formula: $g_R \approx Z/A$. (auth)

20215 ON THE CALCULATION OF γ-TRANSITIONS OF THE M3 TYPE AND OF FORBIDDEN SECOND ORDER β-TRANSITIONS IN THE NILSSON MODEL. D. Bogdan (Institutul de Fizica Atomica, Academia R. P. R., Bucharest). Zhur. Eksptl'. i Teoret. Fiz., 40: 801-8(Mar. 1961). (In Russian)

Expressions are derived for the probabilities of γ-transitions of the M3 type and for forbidden second order β-transitions of the pure Gamow–Teller type. A concrete study of the M3 transitions known in deformed nuclei indicate that in these cases it is not necessary to use the corrected Nilsson representation. However, a study of improbable M3 transitions and second order forbidden β-transitions indicates that if some definite selection rules are obeyed, an application of the corrected Nilsson representation just about doubles the transition probability. (auth)

20216 ON A FUNCTIONAL EXPANSION OF THE SCATTERING MATRIX IN NORMAL PRODUCTS OF ASYMPTOTIC FIELDS. B. V. Medvedev (Inst. of Mathematics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 826-38(Mar. 1961). (In Russian)

Formulas which formally yield the coefficient functions of the scattering matrix expansion in normal products of asymptotic fields in terms of time-ordered products of the current operators and a set of some operators Λ_ν are established by an axiomatic method without applying perturbation theory. Some equation sets for the scattering matrix coefficient functions are also derived. (auth)

20217 EQUATIONS FOR PHOTOPRODUCTION OF PIONS ON NUCLEONS WITH ACCOUNT OF PION-PION INTERACTION. L. D. Solov'ev, G. Byalkovski, and A. Yurevich (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 839-47(Mar. 1961). (In Russian)

Equations for the partial amplitudes for photoproduction of pions on nucleons at low energies are obtained from the Mandelstam representation in the Cini–Fubini approximation. Nucleon recoil and pion-pion interaction are taken into account. The pion-pion interaction yields a contribution only to the isotope-scalar photoproduction amplitudes. Expressions in which pion-pion interaction is taken into account are obtained for these amplitudes. (auth)

20218 ON A METHOD OF SUCCESSIVE EXTENSION OF THE SPECTRAL FUNCTIONS IN THE MANDELSTAM REPRESENTATION. F. M. Kuni and I. A. Terent'ev (Leningrad State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 866-78(Mar. 1961). (In Russian)

A method is developed which permits one to extend the range of knowledge of the spectral functions and absorption parts by a number of successive steps on basis of a knowledge of the absorption part of the scattering amplitude specified in the physical region. With the help of this method the NN-scattering amplitude can be expressed in terms of the $\pi\pi$- and πN-scattering amplitudes specified only in the physical regions. (auth)

20219 ON THE ANALYSIS OF THE DISTRIBUTION OF REACTION PRODUCTS IN LIGHT NUCLEI. B. L. Birbrair (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 895-7(Mar. 1961). (In Russian)

Measurement of the angular distributions at energies $E_\pm = E_r \pm \Gamma_r/2$ and $E_0 = E_r$ where E_r and Γ_r are respectively the isolated resonance energy and width, permits one to single out the contribution from the direct mechanism to the cross section of the reaction. (auth)

20220 ON THE DEPENDENCE OF THE ANGULAR DISTRIBUTION OF FISSION FRAGMENTS ON THE SPIN OF THE TARGET NUCLEUS. V. M. Strutinskii. Zhur. Eksptl'. i Teoret. Fiz., 40: 933-5(Mar. 1961). (In Russian)

A simple analytic expression for the angular distribution of fission fragments has been derived in the case of small anisotropy. The effect of the initial nuclear spin is discussed. (auth)

20221 PAIRING FORCES AND PAIR CORRELATIONS IN THE Tl^{206} AND Bi^{210} NUCLEI. L. A. Sliv, G. A. Sogomonova, and Yu. I. Kharitonov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 946-53 (Mar. 1961). (In Russian)

The residual pairing forces between a proton and neutron in a nucleus are determined. The energies, eigenfunctions and transition probabilities in the Tl^{206} and Bi^{210} nuclei are obtained and compared with the experiments. (auth)

20222 THEORY OF THE CONSERVING VECTOR CURRENT AND OF THE COMPLETE SYMMETRY OF WEAK INTERACTIONS. E. M. Lipmanov (Stalingrad Pedagogical Inst.). Zhur. Eksptl'. i Teoret. Fiz., 40: 980-1(Mar. 1961). (In Russian)

It is pointed out that one of the reasons of the difference of the bond constants may be due to the non-conservation of weak vectorial current, even if the corrections for electromagnetic and weak interactions are not taken into consideration. Such calculations are essential for obtaining information about the intermediate heavy vectorial mesons for introducing corrections for weak radiations. In spite of the attractiveness of the assumption that π decay is completely symmetrical, the difference between the bond constants of the β and the μ decay does not have to invoke it. (TTT)

20223 FISSIONING OF NUCLEI BY π-MESONS. D. F. Zaretskii and V. M. Novikov. Zhur. Eksptl'. i Teoret. Fiz., 40: 982-3(Mar. 1961). (In Russian)

Presence of mesons increase the fission barrier of the nucleus; the effect of mesons in the 1S state increases the probability of fission as a function of the nearness of the threshold energy to the excitation energy. For uranium-238 the fission threshold is higher than the excitation energy while in case of plutonium-239 it is about 0.3 Mev lower. Fissioning of nuclei by mesons according to the above mechanism was studied for uranium-238 but it is proposed that plutonium-239 presents a better subject for such investigations. (TTT)

20224 MEASUREMENT OF THE ANGULAR DISTRIBUTION IN THE $Al^{27}(p,p')Al^{27}$ REACTION BY MEANS OF A MAGNETIC ANALYZER AT E_p = 6.6 Mev. S. S. Vasil'ev E. A. Romanovskii, and G. F. Timushev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 972-3(Mar. 1961). (In Russian)

A previously described magnetic analyzer was used for measuring the angular distribution of 6 elastically and inelastically scattered groups of protons at the following excitation levels: 0.840, 1.014, 2.743, 2.216 and the doublet 2.976 and 2.999 Mev, using Al^{27} for scattering. The protons were accelerated in the 120 cm cyclotron of the Institute of Nuclear Physics, using a collimating slit for obtaining a monochromatic beam with a total dispersion of about 45 kev and a ZnS scintillation counter for detection. The total cross section at the 6 levels was about 700 millibarns, or more than the cross section of the component nucleus. The angular distribution and the orbital momentums transferable to the nuclei are listed. (TTT)

20225 A METHOD FOR MEASURING THE CROSS SECTION OF THE PHOTO-PRODUCTION OF π^+ IN HYDROGEN AT THE THRESHOLD. M. I. Adamovich, E. G. Gorzhevskaya, V. M. Popova, and F. R. Yagudina (Lebedev Physical Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 974-6(Mar. 1961). (In Russian)

The method developed is based on the differences in the character of the kinematic properties of photo-production in hydrogen and in carbon, and on the differential behavior near the reaction threshold. Experimental conditions are facilitated by the previous observation that photoproduction of π-mesons has a mononucleonic character. The tests were made with a polyethylene target in the $E_{\gamma\ max}$ = 175 Mev neutron beam of the synchrotron. It is anticipated that even more useful data can be obtained with heavy polyethylene. (TTT)

Particle Accelerators

20226 (BNL-5392) PROPERTIES OF SLANTED TARGET BEAM PULSING SYSTEM. J. V. Kane, M. A. El-Wahab, J. Lowe, and C. L. McClelland (Brookhaven National Lab., Upton, N. Y.). Apr. 11, 1961. 19p.

The use of a slanted target to shorten the duration of a positive ion beam pulse is described. This is a special case of the method proposed by F. L. Shapiro. Time resolutions of 0.4×10^{-9} seconds were observed for the time spectrum of prompt γ rays from a target during bombardment with a pulsed beam from the Brookhaven National Laboratory Van de Graaff. This figure includes the finite resolution of the scintillation counter employed in the measurements. (auth)

20227 (BNL-5482) THE SIGNAL-FLOW DIAGRAM FOR THE AGS RADIO-FREQUENCY SYSTEM. Harold Hahn (Brookhaven National Lab., Upton, N. Y.). Apr. 28, 1961. 8p.

The equations for the phase oscillations of particles in synchrotrons are developed and represented topologically by a signal-flow diagram. (D.L.C.)

20228 (BNL-5483) RADIUS CONTROL SYSTEM. H. J. Halama (Brookhaven National Lab., Upton, N. Y.). Apr. 26, 1961. 11p.

Design of a closed loop system is described which detects the radial displacement of the center of the charge of proton bunches for use in controlling the AGS beam radius. (J.R.D.)

20229 (DESY-A2.68) MAGNETSTROMVERSORGUNG: SCHALTUNG ZUR ERZEUGUNG EINES LANGEN TEILCHENPULSES. (Magnet Power Supply: Circuit for the Generation of Long Particle Pulses). Bothe (Deutsches Elektronen-Synchrotron, Hamburg). Nov. 9, 1960. 11p.

In order to obtain longer voltage duration, a form is given for the 12-unit circuit proposed for the magnet power supply of DESY. The parameters of the system are given, and proposed curves of the current and voltages are shown. The conceivable combinations for the dimensioning of the circuit are discussed, and the condenser charge is considered. (J.S.R.)

20230 (DESY-A2.75) BERECHNUNG DER HOCHFREQUENZRINGLEITUNG. (Calculation of the High Frequency Ring Circuit). Hassenpflug (Deutsches Elektronen-Synchrotron, Hamburg). Mar. 27, 1961. 28p.

The peripheral amplitude, the relative amplitude variation, the reflection coefficient at the circuit imput, and the circuit losses in the mismatching of an acceleration gas was calculated when the system was operated with the frequency given for the ideal resonance. (tr-auth)

20231 (INS-TH-31) PRELIMINARY REPORT ON THE RADIOFREQUENCY ACCELERATION OF 1 Bev ELECTRON SYNCHROTRON. T. Kamei and T. Nishikawa (Tokyo Univ. Inst. for Nuclear Study). Sept. 18, 1957. 8p. (In Japanese).

The preliminary study was completed on the r-f accelerating system of the 1-Bev electron synchrotron. The accelerating frequency is the 16th harmonic of the orbital frequency, 138.1 mc, and the cavity is a re-entrant cylinder. The peak-gap voltage should be 20 to 30 kv to accelerate the injected electrons with good efficiency. The cavity can be excited by a self-exciting oscillator or by a r-f power amplifier. The technical feasibilities of the excitation systems are discussed. (auth)

20232 (JINR-P-355) TSIKLOTRON S PERIODICHESKIM MAGNITNYM POLEM DLYA MNOGOZARYADNYKH IONOV. (Cyclotron with Alternating Magnetic Field for Multicharged Ions). V. P. Dmitrievskii, B. I. Zamolodchikov, and V. V. Kol'ga (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 12p.

A cyclotron with alternating magnetic field is suggested for accelerating multicharged ions. The phase motion of ions in the accelerator and conditions for spatial stability are investigated. Approximate calculations are given for cyclotron parameters designed for accelerating ions with charge-mass ratios of $\frac{1}{3}$ to $\frac{1}{7}$. (tr-auth)

20233 (JINR-P-360) DEISTVIE MNOGOKRATNOGO RASSEYANIYA I IZLUCHENIYA PRI NAKOPLENII ELEKTRONOV V USKORITELYAKH. (Effects of Multiple Scattering and Radiation on the Accumulation of Electrons in Accelerators). V. I. Kotov, A. B. Kuznetsov, and N. B. Rubin (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1959. 9p.

The simultaneous build-up action of free vertical oscillations due to scattering by residual gas and their radiative attenuation with electron accumulation in cyclic accelerators was analyzed. Formulas are derived for the finite mean square amplitude and for the electron loss probability at arbitrary times. It is shown that the life of an accumulated electron beam can be extended almost infinitely due to the radiative attenuation. (tr-auth)

20234 (JINR-P-367) VYSOKOVOL'TNAYA USTANOVKA NA 300 KEV DLYA USKORENIYA IONOV TRITIYA I GELIYA. (High Voltage 300 kev Installation for Accelerating Tritium and Helium Ions). V. I. Salatskii and I. V. Sizov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 27p.

Descriptions are given of a 300-kev accelerator designed for hydrogen and helium ion acceleration. The installation is supplied by a radiofrequency ion source operating with low gas consumption, electron stabilization of high voltage and magnet current, regenerative gas system, and adequate protection against x-ray and neutron emissions. (tr-auth)

20235 (JINR-P-513) TRASSIROVKA NEITRAL'-NOGO PUCHKA CHASTITS S POMOSHCH'YU GAMMA-ISTOCHNIKA. (Neutral Beam Scanning with γ Source). L. Ozhdyani, V. S. Pantuev, and M. N. Khachaturyan (Joint Inst. for Nuclear Research. Dubna, U.S.S.R. Lab. of High Energy). 1960. 7p.

A method is suggested for locating neutron beam paths in synchrotrons. The problem was resolved for a case in which a given target was located outside the chamber and the axis of the vacuum chamber is determined by a known system axis. The method enables efficient and fast (order of one hour) tracking of beams at considerable distances. (R.V.J.)

20236 (NP-10271(p.28-31)) A POSSIBLE VISCOUS INSTABILITY IN THE ELECTRON STORAGE RING. D. C. dePackh (Naval Research Lab., Washington, D. C.).

The possibility of a transverse viscous instability in the electron storage ring is discussed. The instability results from the necessary presence of a conducting tube around the beam and is directly caused by transverse forces produced by m = 1 current distribution on the tube. If q is small, the characteristic growth distance of the instability under the worst conditions is of the order of 1/q times the betatron wavelength, and one can easily show that its characteristic growth time is 1/q times the tube time constant. Probably the best way to limit it is to reduce to a minimum the excitation of frequencies in the unstable band by increasing the tube time constant relative to the operating cycle. (N.W.R.)

20237 (NP-10271(p.32-47)) A SOLENOID-FOCUSED GUIDE RING FOR THE STORAGE OF AN INTENSE ELECTRON BEAM. D. C. dePackh (Naval Research Lab., Washington, D. C.).

A form for a large solenoid-focused storage ring in which the behavior of a space-charge-limited electron beam can be studied is described. The vacuum tube is two inches in diameter and has a major diameter of 31 ft. Other applications besides its purpose of capturing an SCL beam in a closed circuit are: as an accelerator, a ring of this kind can produce x-rays of an intensity enormous compared with that of a conventional betatron; current densities ranging from 10^6 to 10^8 amp/cm^2 can be produced if predicted beam compressions occur under stable conditions; and intense electromagnetic radiation should be available at very short wavelength and at powers of the order of 10^9 w for a hypothetical efficiency of one percent and a hypothetical beam of 1000 amp at 100 Mev. (N.W.R.)

20238 (TID-12580) COMPARISON OF THE CONSTANT GRADIENT AND UNIFORM ACCELERATOR STRUCTURES. R. B. Neal (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Mar. 1961. Contract AT(04-3)-363. 22p. (M-259)

A summary of earlier results obtained in comparison of the constant gradient and the uniform accelerator structure is presented and the structures are further compared on the basis of frequency sensitivity and beam loading derivative (dV/di). The emphasis is placed on a particular case in which the constant gradient conditions are obtained when i = 0. (J.R.D.)

20239 (AEC-tr-3971(p.155-9)) THE TERM "CYCLOTRON RESONANCE." Translated from Uspekhi Fiz. Nauk, 61: No. 1, 133-5(1957).

The use of the term "cyclotron resonance" to describe the effect resulting from electric dipole transitions, induced by the electric component of the same field of radiation is discussed. The use of the term "diamagnetic resonance" is suggested. (M.C.G.)

20240 (CEA-tr-X-351) SCHÉMA ET DIMENSIONS D'UNE SOURCE D'IONS DU TYPE À ARC COLLIMATÉ DANS UN CHAMP MAGNÉTIQUE. I. (Construction Plan for an Arc Collimated Ion Source in a Magnetic Field. I). Manlio Abele and Wolfgang Meckbach (Argentina. Comisión Nacional de Energiá Atómica, Buenos Aires). Translated into French by L. Bory from Report No. 7. 1959. 52p.

An experimental ion source of the hot-cathode arc-discharge type was built. The arc is collimated in a magnetic field, and extraction of the ion beam is axial. Detailed measurements were made of the characteristics of the ion source. The maximum total ion current obtained was 40 ma. The existence of secondary electrons was established. Their perturbative effects on the current measured are to be eliminated. The calorimetric measurements made on the target are in agreement with the electric measurements. Appropriate means for control and modulation of the beam of the source are described. (tr-auth)

20241 (CEA-tr-X-360) GENERATEUR A CASCADE DE 600 kV AYANT UN SYSTEME DE CHAUFFAGE DE RADIOFREQUENCE ET ACCELERATEUR FONCTIONNANT EN MILIEU HOMOGENE. (A 600 kv Cascade Generator Having a Radiofrequency Injection System and Accelerator Operating in Homogeneous Medium). Gabor Kalman and Laszlo Varga. Translated into French by Simonyi Karoly from Magyar Tudomanyos Akad. Kozponti Fiz. Kutato Intezetenek Kozlemenyei, 5: 402-13(1957). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 22314.

20242 A NEW TYPE OF IONIC SOURCE. J. Habanec (Inst. of Nuclear Research. Academy of Sciences, Prague). Czechoslov. J. Phys., 11: 223-4(1961). (In English)

Ion production strongly depends on the oscillations, their amplitude, and frequency. Ionization was 8 times greater for a d-c–a-c voltage ratio of about 4 : 1 at 3×10^{-4} mm Hg. With a discharge in a magnetic field, an increase in ionization of 50% was achieved. The frequency of the Barkhausen oscillations coincides with the oscillations, increasing the ionization. The actual increase in ionization occurs by increasing the density of the electron cloud emitted from the cathode when the amplitude of high-frequency voltage on the grid is positive. Resonance between the electrons in the discharge path and the high-frequency system may be used for a new type of ion source with increased ionization. (P.C.H.)

20243 ON ELECTRON LOSSES IN A SYNCHROTRON DUE TO THE QUANTUM NATURE OF THE RADIATION. P. S. Landa (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1119-23(Apr. 1961). (In Russian)

An explicit expression for the probability of electron losses has been obtained using an approximate solution of the nonstationary Fokker-Planck equation, nonlinearity of phase oscillations being taken into account. It is shown that the probability for electron losses is increased as a result of taking into account the nonlinearity, but the increase is insignificant and is of the order of unity. A simple approximate formula for calculation of the probability of electron losses is proposed. (auth)

20244 PHYSICS AROUND "SATURN." J. Crussard (Commissariat à l'Energie Atomique, Saclay, France). Energie nucleaire (France), 3: 139-47(Mar.-Apr. 1961). (In French)

The beam and target facilities at the Saturne proton synchrotron are described. Basic research, including elementary particle production, decay, and interaction experiments, is outlined. Particular attention is devoted to

π-p interactions at p energies of 0.5 to 1.5 Bev, and to K meson and hyperon research. The detectors, including counters and bubble chambers, at Saturne are described. (T.F.H.)

Plasma Physics and Thermonuclear Processes

20245 (AFOSR-747) ON MAGNETOHYDRODYNAMICS STABILITY OF A SELF-GRAVITATING PLASMA. R. K. Jaggi (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Feb. 1961. Contract AF18(600)-1315. 28p. (BN-231)

The following Kruskal and Schwarzschild boundary conditions are deduced which apply on the free surface of a self-gravitating plasma. These equations are applied to study the stability problems of a self-gravitating plasma. It is proved that the stable length of the compression waves in an infinite homogeneous plasma is increased by the presence of a uniform magnetic field. The stability of a self-gravitating plasma cylinder of infinite length is worked out and it is seen that a magnetic field of the order of $5 \cdot 10^{-6}$ gauss increases the stable length of the plasma cylinder by more than ten times. (auth)

20246 (JPL-TR-32-81) INTERACTION OF A QUANTUM PLASMA WITH ELECTROMAGNETIC FIELDS. Hugo Wahlquist (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 15, 1961. Contract NASw-6. 17p.

The quantum-mechanical distribution function (q.m.d.f.) approach is extended to obtain the response of a quantum plasma to classical transverse electromagnetic fields. The interaction is treated in a self-consistent-field approximation. A perturbation calculation is carried through for the case in which the plasma departs only slightly from equilibrium. The usual result for the permittivity of the plasma is derived. The permeability of a cold, degenerate plasma is evaluated. (auth)

20247 (MATT-71) RECOMBINATION IN HELIUM PLASMA. R. W. Motley and A. F. Kuckes (Princeton Univ., N. J. Plasma Physics Lab.). May 1961. Contract AT(30-1)-1238. 18p.

Studies of plasma loss in the afterglow of discharges in the B-1 stellarator show that the three-body recombination reaction $He^+ + e^- + e^- \rightarrow He^* + e^-$ is the principal mechanism for charge removal in a highly-ionized, low temperature helium plasma. This conclusion is drawn from evidence obtained from microwave measures of the time dependence of the plasma electron density and from conductivity measurements of the electron temperature. (auth)

20248 (NP-10180) CYCLOTRON RESONANCE AND DE HAAS–VAN ALPHEN OSCILLATIONS OF AN INTERACTING ELECTRON GAS. Technical Report No. 6. Walter Kohn (California. Univ., La Jolla). nd. Contract NONR-2216(11). 17p.

An electron gas with short-range interactions is considered in the presence of a uniform magnetic field. It is shown that the cyclotron resonance frequency is independent of the interaction, and, for a two-dimensional gas, the De Haas–Van Alphen period is independent of the interactions. Low-lying excited states are discussed. (auth)

20249 (NP-10185) MAGNETOGASDYNAMIC CONE FLOW FOR THE SPECIAL CASE OF INFINITE CONDUCTIVITY AND ALIGNED FIELDS. Jerome J. Brainerd (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). [1959?]. Contract Nonr-401(25). 113p.

The problem of steady, inviscid, magnetogasdynamic flow past an unyawed infinite cone is studied for an applied magnetic field aligned with the free stream, where the conductivity of the gas ahead of the shock wave is considered to have a value of zero or a value of infinity. In both cases, the conductivity of the gas between the shock wave and the cone is assumed to be infinite, and it is assumed there are no currents ahead of the shock wave. When these two assumptions are satisfied, the two cases are the same. Solutions to the problem are found for two distinct flow regimes, using an incompressible approximation to the flow between the shock and the body. The first flow regime is a modification of the ordinary gasdynamic flow, and occurs for supersonic ($M_1 > 1$) and superalfvénic ($A_1 > 1$) freestream conditions. The second flow regime is essentially different from the ordinary gasdynamic flow, being characterized by a forward-facing shock wave, and occurs for subsonic ($M_1 < 1$) and subalfvénic ($A_1 < 1$) freestream conditions, but with the restriction $M_1^2 + A_1^2 > 1$. The shock wave in the first regime is a fast shock, and in the second regime is a slow shock. The shocks are characterized by the fast and slow magnetoacoustic speeds, respectively. In both flow regimes, the flow between the shock and the body is compressive, although an incompressible approximation is made. Also in both regimes, increasing the magnetic field intensity, for otherwise constant freestream conditions, reduces the size of the cone necessary to generate a shock wave at a given angle. (auth)

20250 (ORO-403) COLLECTIVE INTERACTIONS OF A BEAM WITH A PLASMA. Technical Report No. 1. D. L. Lafferty and B. N. A. Lamborn (Florida. Univ., Gainesville). May 5, 1961. Contract AT-(40-1)-2783. 23p.

An investigation of the electrostatic interactions of a beam of charged particles with a homogeneous plasma indicated the presence of a spectrum of resonances in the system. The analysis was based on a collective description of the beam-plasma system. The equations of motion of the various Fourier components of charge density are represented by a set of coupled, non-linear differential equations of the Hill type. The general equations can be simplified considerably for certain cases of practical interest. (auth)

20251 (PIBMRI-859-60) THE THEORY OF PLASMA RADIATION. A. Isihara (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Oct. 12, 1960. Contract AF30(602)-2045. 19p. (RADC-TN-60-255; AD-248052)

The electromagnetic field of a fully ionized plasma is considered. It is shown that there exist two different types of radiation, one being characteristic of equilibrium plasmas and the other being intrinsic to non-equilibrium plasmas. The latter radiation is determined by the time rate-of-change of the distribution function and is investigated for the case where the change in the distribution function is caused by collisions between plasma particles. Because of the statistical method adopted, it is possible to take not only two-body but many-body collisions into consideration. As a result, the radiation field is related to a statistical quantity, such as the pressure. The spectral analysis of the radiation is given, and the coupling between forces in the plasmas and radiation is duscussed. (auth)

20252 (SCTM-11-61(71)) PRELIMINARY STUDY OF SPECTROGRAPHIC TEMPERATURE MEASUREMENTS OF AN ARGON PLASMAJET. K. L. Shipley (Sandia Corp., Albuquerque, N. Mex.). May 1961. 14p.

Spectrographic temperature measurements of an argon plasmajet were investigated. Methods used in this preliminary study included stark broadening of hydrogen lines, and relative intensities of argon lines. Results are given,

and plans for further spectrographic studies are outlined. (auth)

20253 (UCRL-4743) MACROSCOPIC PROPERTIES OF A ONE-DIMENSIONAL PLASMA CONFINED BY A MAGNETIC FIELD. Hugh W. Batten and Cornelius H. Woods (California. Univ., Livermore. Radiation Lab.). Sept. 4, 1956. Contract W-7405-eng-48. 26p.

The quantities of interest in a confined plasma include the electric and magnetic fields, current density, diffusion velocity, temperature, pressure, and particle density. Equations governing the distribution of these variables are given, and special cases of a one-dimensional steady-state plasma are examined. The solutions are given graphically. (auth)

20254 (UCRL-4954) THE MECHANISM OF FAILURE IN CORONA DISCHARGE. Clelland D. Nail (California. Univ., Livermore. Radiation Lab.). Sept. 1, 1957. Contract W-7405-eng-48. 21p.

Experimental evidence is given which indicates that electronic bombardment is responsible for damage and failure of insulating material subjected to intense corona attack. The experimental results are further supported by some theoretical considerations of the energy-time properties of corona discharges. (auth)

20255 (UCRL-6232-T) DIAGNOSTIC MEASUREMENTS OF A HIGHLY IONIZED, STEADY-STATE PLASMA. Andrew L. Gardner (California. Univ., Livermore. Lawrence Radiation Lab.). 1960. Contract W-7405-eng-48. 31p.

Some of the diagnostic techniques which were applied to a highly ionized, steady-state He plasma are described. The P-4 system for plasma production is described. Microwave equipment used to measure the plasma and electron densities are discussed. Electrostatic probes were used to measure the electron temperature, ion density, and space potential. Species causing the plasma spectrum are reported. Ion temperature determination by Doppler broadening measurements with a Fabry-Perot interferometer is discussed. (D.L.C.)

20256 (UCRL-9509) ION DENSITY MEASUREMENTS IN A DECAYING HYDROGEN PLASMA. William S. Cooper, III, Alan W. DeSilva, and John M. Wilcox (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1, 1961. Contract W-7405-eng-48. 29p.

A hydrogen plasma was prepared for Alfvén wave experiments and was allowed to decay. The shapes of the Stark broadened line profiles of the first three members of the Balmer series, H_α, H_β, and H_γ, were measured as functions of time and were matched with theoretical line profiles calculated by Griem, Kolb, and Shen to obtain the ion density as a function of time. In the 300 μsec during which the line profiles were observed the ion density decayed from 5.0×10^{15} cm^{-3}, to 1.5×10^{15} cm^{-3}, and extrapolated back to 5.5×10^{15} to 7.1×10^{15} cm^{-3} at the time the discharge current was terminated, corresponding to 85 to 100% ionization of the hydrogen initially in the tube. A nearly pure Balmer spectrum, merging with the continuum after nine lines, was observed. The observed depression of the series limit indicated a time-averaged ion density of about 3×10^{15} cm^{-3} in good agreement with the measurements from the profiles of the three individual lines. The observed velocity of Alfvén waves in the plasma yielded a value for the ion density that was also in good agreement with these spectroscopically determined values. The temperature was estimated to be about 10,000°K. The plasma probably decays by a volume recombination process in the manner described by D'Angelo. (auth)

20257 (UCRL-9601) EXPERIMENTAL STUDY OF HYDROMAGNETIC WAVES IN PLASMA. (thesis). Alan W. DeSilva (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 17, 1961. Contract W-7405-eng-48. 105p.

An experiment is described in which a torsional hydromagnetic wave is excited in a cylindrical hydrogen plasma. The theory of the wave is briefly described and expressions are derived for the wave velocity, attenuation, field distributions, and the tube input impedance. Measurements are presented which verify the linear dependence of wave velocity on magnetic field and show fairly good agreement with theory for variation of mass density. The temperature of the plasma is determined experimentally by a direct resistivity measurement, and is found to agree well with the observed temperature derived from wave damping. The variation of attenuation constant with magnetic field is shown to be consistent with theory. Reflections of the waves occurring from insulating and conducting boundaries, and from a plasma-neutral gas interface are described. In all cases the phase changes at reflection are in agreement with theory. The radial magnetic field distributions are experimentally investigated and compared to theoretical predictions based on a modal analysis of the driving pulse. A description is given of the plasma preparation process and of measurements of the plasma properties, which show that the plasma is >85% ionized with an ion density $>5 \times 10^{15}$ cm^{-3} and has a temperature of about 12,000°K. (auth)

20258 (USCEC-56-209(Suppl.1) DIFFUSION OF A FULLY IONIZED GAS CONFINED IN A STRONG MAGNETIC FIELD. Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). Apr. 12, 1961. Contract AF18(603)-95. 5p. (AFOSR-TN-59-1162 (Suppl.1)).

After consideration of elastic collision models of particles some previous assumptions and conclusions concerning the diffusion of a fully ionized gas confined in a strong magnetic field were revised. The calculations of terms of collisions between electrons and ions were changed. (M.C.G.)

20259 (CEA-tr-A-894) COMPRESSION D'UNE COLONNE DE PLASMA PAR UN CHAMP MAGNETIQUE QUADRIPOLAIRE. (Compression of a Column of Plasma by a Quadrupole Magnetic Field). J. Christianssen. Translated into French from Z. Naturforsch., 13a: 951-61 (1958). 36p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 5773.

20260 (CEA-tr-A-944) FREINAGE D'UN FAISCEAU IONIQUE MODULE DANS UN MAGNETOPLASMA. (The Energy Emission of a Modulated Ion Beam in a Plasma with Magnetic Field). R. Kippenhahn and H. L. Vries. Translated into French from Z. Naturforsch., 15a: 506-12 (1960). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 22503.

20261 MAGNETO-FLUID-DYNAMIC WAVES. Rolf K. M. Landshoff (Lockheed Missiles and Space Div., Palo Alto, Calif.). Appl. Mechanics Revs., 14: 339-44(May 1961).

An outline of magnetofluiddynamics is presented. Basic equations are given, followed by special cases such as linear systems, systems with no d-c magnetic field, and systems with Alfvén waves. A discussion of more generalized systems is presented, including anisotropic wave propagation, frequencies at which dispersion relations are

invalid, partly ionized gases, inhomogeneous or slowly varying media, boundary conditions, and transition regions with a singular index of refraction. (T.F.H.)

20262 EXPERIMENTS ON THE CONFINEMENT OF AN ELECTRON GAS IN A MAGNETIC FIELD. B. Bonnevier (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 18: 421-31(1961). (In English)

The confinement of electrons in different types of magnetic "bottles" is studied experimentally. A cathode is placed inside the confinement region and the electron current to the surrounding walls is measured as a function of the magnetic field strength. Toroidal and mirror-shaped fields are examined as well as the field generated by a circular current loop. The experiments indicate that the field generated by the current loop can be used to trap particles in all directions. Further, it is found that the suppression of the total electron current is controlled only by the poloidal part of the magnetic field, as predicted by theory. (auth)

20263 EQUILIBRIUM AND STABILITY FOR MAGNETOHYDRODYNAMIC TOROIDAL SYSTEMS AT SCALAR PRESSURE IN THE VICINITY OF A MAGNETIC AXIS. Claude Mercier and Michel Cotsaftis. Compt. rend., 252: 2203-5(Apr. 10, 1961). (In French)

The equilibrium equations and the general criterion for stability in the vicinity of a magnetic axis of a configuration were developed. No equilibrium exists when the total rotational transformation angle is a multiple of 2π. For very weak currents, the stability is connected to the direction of the concavity of the pressure on the axis. (tr-auth)

20264 SOME EXACT SOLUTIONS OF UNSTEADY MOTION EQUATIONS IN MAGNETIC HYDRODYNAMICS. Yu. P. Ladikov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 137: 303-6(Mar. 11, 1961). (In Russian)

Equations had been derived for non-steady-state flow of gas with spherical symmetry where the gas possesses a radial velocity which is proportional to the radius. These equations are further developed and extended for the case of a gas with infinite conduction that is subjected to the action of an axially symmetrical, magnetic field with the gas rotating with respect to the axis of symmetry. The derived equations show that under certain conditions the gas particles rotate with a variable angular velocity and that the distance of the particles from the center of symmetry decreases and increases periodically. Equations for the pulsations of a rotating plasma cylinder are presented. Depending on the values of four arbitrary constants A, B, C and D, it turns out that the gas particles rotating around the axis of symmetry can fly toward the axis, go to infinity, or they may acquire a periodic, pulsating, radial motion. These equations may be used to investigate the pulsations of a rotating plasma cylinder of finite radius R. (TTT)

20265 THE STRUCTURE OF SLOW MAGNETOHYDRODYNAMIC SHOCK WAVES UNDER BAROTROPIC CONDITIONS. A. G. Kulikovskii (Steklov Inst. of Mathematics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 137: 810-13(Apr. 1, 1961). (In Russian)

It has been shown that in a set of four ordinary differential equations which describe the unique steady-state flow of a gas, there are not more than four characteristic points S_1, S_2, S_3, and S_4, and it has been demonstrated that there exists a unique integral curve for the $S_1 \rightarrow S_2$ transition which corresponds to a fast shock wave. If the pressure is a function of only the specific volume, the number of equations is reduced to three and it is proved that slow shock waves always possess a structure, that is, the points S_3 and S_4 are joined by an unique integral curve for any values of the dissipative coefficients. The assumption of barotropic conditions is convenient, since the problem is reduced to a study of the integral curves in three-dimensional space. (TTT)

20266 SOME FEATURES OF THE TRANSVERSE PROPAGATION OF HIGH-FREQUENCY WAVES IN A MAGNETIC PLASMA. B. N. Gershman (Gor'kii State Univ., [USSR]). Doklady Akad. Nauk S.S.S.R., 137: 822-5(Apr. 1, 1961). (In Russian)

The thermal motion of electrons results in the propagation of high-frequency waves in a direction perpendicular to the magnetic field in a homogeneous plasma. The kinetic equation derived by Gross predicts the occurrence of narrow forbidden zones or slits for frequencies close to the rotational frequency of the electron, where the transverse propagation of high-frequency waves is not allowed. However, it is pointed out that this nonrelativistic analysis by Gross is insufficient and that a relativistic correction for the change in mass of the electron versus its velocity must be applied. On application of the relativistic correction, it is shown that resonances occur for certain types of waves, but that no changes in the type of propagation take place. No essential irregularities in the behavior of plasma waves occur. (TTT)

20267 A DISPERSION RELATION FOR WAVES OF FINITE AMPLITUDE IN A TWO-STREAM PLASMA. F. D. Kahn (Univ. of Manchester, Eng.). J. Fluid Mech., 10: 357-65(May 1961).

A dispersion relation is derived for plane space-charge waves of finite amplitude in a plasma containing two oppositely charged streams of particles. The relation may be expressed simply in parametric form; it can also be approximated, in two different ranges of amplitude, by expressions for the wavelength in terms of the maximum variation of the electrostatic potential. (auth)

20268 MAGNETOHYDRODYNAMIC FLOW CONSTRUCTIONS WITH FUNDAMENTAL SOLUTIONS. Meredith C. Gourdine (Plasmadyne Corp., Santa Ana, Calif.). J. Fluid Mech., 10: 439-48(May 1961).

Steady flows of an incompressible, viscous, electrically conducting fluid over solid bodies are constructed from fundamental solutions of magnetohydrodynamics, in which the applied magnetic field is parallel to the velocity at infinity. The flat plate and the sphere are considered as examples, and approximate solutions are presented for the limiting cases of large and small Reynolds and magnetic Reynolds numbers. The effects of currents in the body are also considered, and it is found that unless the magnetic Prandtl number is larger than unity, currents in the body have negligible effect on the flow. (auth)

20269 THE ACTION OF VLASOV WAVES ON THE VELOCITY DISTRIBUTION IN A PLASMA. J. W. Dungey (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Fluid Mech., 10: 473-9(May 1961).

A one-dimensional plasma model with no magnetic field is considered. It is supposed that the plasma starts in thermal equilibrium and that a current is then forced to grow. Instability leads to the growth of waves, which are shown to stir the distribution in phase space, but only over a limited range of velocity. It is concluded that in order to restore stability the energy in the wave must become comparable to the energy of drift. (auth)

20270 INSTABILITY WAVES IN MAGNETICALLY CONFINED PLASMAS. A. A. Ware (A.E.I. Research Lab., Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.—Accelerators—Thermonuclear Research, 3: 93-7(Apr. 1961). (In English)

In most of the treatments of hydromagnetic stability, the perfect conductivity approximation is made, ignoring the Hall e.m.f. For small amplitude perturbations with frequency $\omega/2\pi$, the calculated solutions for ω^2 are always real, and for an unstable discharge ($\omega^2 < 0$) there are no oscillations or wave motion. Experimentally, however, wave motion is observed. It is pointed out that if the Hall e.m.f. is retained, wave motion is obtained theoretically, in quantitative agreement with experiment. The full set of hydromagnetic equations is not solved; instead a physical picture of the wave motion is obtained by considering the property of 'freezing in' of magnetic lines of force in the plasma. When the Hall e.m.f. is retained the magnetic field is trapped to the mean motion of the electrons. The approximate wave velocity obtained is the component of electron drift velocity perpendicular to the instability. (auth)

20271 REGULAR OSCILLATIONS IN A TOROIDAL DISCHARGE. M. G. Rusbridge, H. W. Jones, D. J. Lees, P. A. H. Saunders, and E. A. Witalis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research; 3: 98-105(Apr. 1961). (In English)

Regular oscillations are detected under a limited range of conditions in a 12 in. bore torus. The electric and magnetic fields associated with these oscillations are investigated and indicate a helical notch of reduced density travelling on the pinched current channel with a uniform velocity. A possible explanation of the phenomenon is given. The oscillation is considered to grow in a manner similar to that of a sound wave in a partially-ionized medium. The mode is cited as an example of a pinched discharge with poor confinement. (auth)

20272 THE LIFETIME OF FAST IONS IN OGRA. G. F. Bogdanov, D. A. Panov, and N. N. Semashko (Academy of Sciences, Moscow). J. Nuclear Energy; Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 106-14(Apr. 1961). (In English)

The lifetime of injected H_2^+ ions and trapped H^+ ions in OGRA is measured. It is found that the mean free path of molecular ions is about 1.5 km for a magnetic field configuration that gives the optimum velocity of azimuthal drift. The maximum lifetime of atomic ions of energy 100 kev is 9.3 ± 0.9 msec at a pressure 1×10^{-7} mm mercury. The lifetime of atomic ions of energy 50 kev is 3.2 msec at a pressure 2.5×10^{-8} mm mercury. The maximum density of atomic ions after injection of 20 ma of H_2^+ ions of energy 200 kev is about 1.5×10^7 cm^{-3}. The dependence of the lifetime on the ion energy and residual gas pressure shows that in OGRA there are no mechanisms of loss of captured ions, other than charge exchange with the residual gas, up to characteristic times of the order of 10 msec. (auth)

20273 MAGNETIC ROTARY POLARIZATION IN PLASMA-APPLICATION TO MEASUREMENT OF ELECTRONIC DENSITY. T. Consoli and M. Dagai (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 115-28(Apr. 1961). (In French)

The rotation of a linearly-polarized wave, propagating parallel to the direction of a static magnetic field, is studied under certain restrictive conditions and for the following range of parameters: 10^8 e/m^3 < electronic density < 10^{24} e/m^3, 10^{-4} gauss < magnetic field < 10^7 gauss, and 10^7 cps < exploring frequency < 10^{15} cps. Theoretical results are given by a family of curves. Two experimental set-ups are described; one measuring the right-hand and left-hand indices, the other their difference (i.e. the rotation of the electric field vector of the emerging wave). (auth)

20274 CALCULATION OF RESONANT FREQUENCIES OF RE-ENTRANT CYLINDRICAL ELECTROMAGNETIC CAVITIES. R. Taylor (Rutherford High Energy Lab., Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 129-34 (Apr. 1961). (In English)

A method is described of calculating the resonant frequencies of cylindrical re-entrant electromagnetic cavities, which provides upper and lower bounds to the required frequency. These bounds converge towards each other as the number of terms in certain harmonic expansions is increased. The lower bound is increased by subtracting from the total field a singular part caused by the presence of sharp corners. Application to cavities of interest in the design of proton linear accelerators shows that accuracies of better than 1 per cent can be obtained without excessive computing time. (auth)

20275 THE SHOCK MODEL OF THE DYNAMIC PINCH. J. A. Reynolds and J. M. P. Quinn (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 135-9(Apr. 1961). (In English)

Various models of the dynamic z-pinch are discussed. Photographic evidence from experiments using hydrogen and deuterium discharges in a straight tube is given in support of a shock model that allows for energy spent in ionization and dissociation. Effectively, the ionization and dissociation reduce γ from 5/3 to the region of 1.2. The temperature of the shocked gas is calculated from the measured shock velocity, and a curve of temperature against initial gas pressure is given. This temperature varies between 0.5 and 25 ev for pressures of 10,000 to 100μ, which corresponds to 10 to 30 per cent of the directed radial energy of the ions. Thus the pinch, during the implosion phase, consists of a rapidly imploding skin of low energy plasma. (auth)

20276 ELECTROSTATIC INSTABILITIES IN OHMICALLY HEATED PLASMAS. J. D. Jukes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 140-5(Apr. 1961). (In English)

The dispersion equation for electrostatic oscillations in a current-bearing plasma is solved for marginal stability when the electron and ion temperatures are unequal. The result is applied to a plasma ohmically heated by a time-invariant current. A criterion for instability is compared with a similar one for the formation of a runaway beam of electrons. Comparison is made with some experiments in which a plasma is ohmically heated, and in which instabilities develop. (auth)

20277 NON-ADIABATIC MAGNETIC TRAPS. E. W. Laing and A. E. Robson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 146-55(Apr. 1961). (In English)

A method of injection into a mirror machine is analyzed by numerical and perturbation solutions of the equations of motion of a single particle. The principle of the method is to inject particles through one of the mirrors, along the lines of force. The magnetic field in the center of the machine has a small, spatially periodic radial component which, for certain initial conditions, causes a resonant interchange of energy from the longitudinal to the transverse component of the particle's velocity. This energy

exchange results in reflection of the particles by the end mirror, and by suitable adjustment of the mirrors the particles may be contained inside the machine for an appreciable number of transits. The possibility of increasing the accumulation of particles by combining this method of injection with molecular-ion dissociation is also discussed. (auth)

20278 SELF-CONSISTENT FIELD THEORY OF PLASMA BETATRONS. G. Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 156-61 (Apr. 1961). (In English)

A quasi-stationary, self-consistent field theory is developed for the space-charge neutralized plasma betatron. It is found that the equilibrium orbit shrinks in the first phase of the acceleration process, and this shrinkage sets a limit to the number of particles that can be accelerated. Exceeding this limit collapses the beam. During the acceleration process, the beam passes through a betatron-damping-dominated and a self-pinching phase, and finally enters the relativistic regime. Limits for these phases, as well as the beam behavior in different phases are given. (auth)

20279 EXPERIMENTAL AND THEORETICAL OBSERVATIONS ON A FAST LINEAR PINCH. D. E. T. F. Ashby, K. V. Roberts, and S. J. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.–Accelerators–Thermonuclear Research, 3: 162-6(Apr. 1961). (In English)

A shock-heated linear z-pinch experiment is described, in which an initial B_z field and strong pre-ionization are employed. The properties of the B_z and B_θ fields, from the plasma axis to the wall, are found from 0 to 2.5 μsec after initiation of the discharge. The B_θ field sweeps the plasma into the central area; a shock is thereby formed in the B_z field, which is pushed to the axis. The observed effects are compared with one-dimensional magnetohydrodynamic predictions. (T.F.H.)

20280 STARK BROADENING OF HYDROGENIC ION LINES IN A PLASMA. H. R. Griem (Univ. of Maryland, College Park and U. S. Naval Research Lab., Washington, D. C.) and K. Y. Shen. Phys. Rev., 122: 1490-6(June 1, 1961).

The frequency distributions of the ionized helium lines at 4686 and 3203 A broadened by the local fields of both ions and electrons in a plasma are calculated in the classical path approximation, which is shown to be always applicable. General formulas are developed for the Stark profiles of lines from multiply ionized hydrogenic systems, and the validity domains of the impact and quasi-static approximation for electron and ion broadening are delineated. The results are compared with the Holtsmark theory and an approximation for high series members. (auth)

20281 ELECTRON OSCILLATIONS IN A MAGNETIZED PLASMA. Asbjørn Kildal (Universitetet, Bergen, Norway). Univ. Bergen Årbok, Naturvitenskap. Rekke, No. 17: 1-10(1959). (In English)

The dispersion equation for electric waves in a plasma, propagated transverse to an external magnetic field, is derived by the use of Newton's second law and Maxwell's equations. This derivation is simpler than that using Boltzmann's equation. (auth)

20282 ON THE ACCURACY OF THE ADIABATIC INVARIANT OF A PARTICLE IN A HIGH DENSITY PLASMA. A. M. Dykhne (Inst. of Radiophysics and Electronics, Siberian Section, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 863-5(Mar. 1961). (In Russian)

An expression for variation of the adiabatic invariant upon reflection of a charged particle from a magnetic mirror is obtained by taking into account the diamagnetism of the plasma. The limiting case of complete expulsion of the magnetic field from the plasma which corresponds to high densities of the plasma is considered. (auth)

20283 CONTRIBUTION TO THE THEORY OF THE INTERACTION BETWEEN A CHARGED PARTICLE AND PLASMA IN A MAGNETIC FIELD. I. A. Akhiezer (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 954-62(Mar. 1961). (In Russian)

The interaction between a nonrelativistic charged particle and electron plasma in the presence of a magnetic field is studied by quantum field theory methods. The dielectric constant is computed and the frequencies and attenuation coefficients of longitudinal oscillations of the plasma in a magnetic field are derived in the first approximation in e^2. A general formula for energy losses of a particle traversing the plasma is deduced. The motion of a particle possessing a velocity much greater than the mean thermal velocity of the plasma electrons is examined in detail. (auth)

20284 ON THE CONDITIONS OF STABILITY OF ELECTRON DISTRIBUTION. A. I. Akhiezer, G. Ya. Lyubarskii, and R. V. Polovin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 963-9(Mar. 1961). (In Russian)

General conditions of stability of electron distribution function with respect to high frequency plasma oscillations are obtained, the collisions being neglected. Free plasma and plasma immersed in a constant and uniform electric or magnetic field are considered. (auth)

20285 ON THE KINETIC THEORY OF SHOCK WAVES. G. Ya. Lyubarskii (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1050-7(Apr. 1961). (In Russian)

Collisions are taken into account in an investigation of the structure of a low intensity shock wave in a neutral perfect gas. At small distances from the shock wave front the wave structure is the same as that given by the hydrodynamic theory which phenomenologically takes into account heat conductivity and viscosity. At large distances the hydrodynamic quantities approach their limiting values at a smaller rate than in the hydrodynamic theory. (auth)

20286 STRUCTURE OF THE TRANSITION LAYER BETWEEN A PLASMA AND A MAGNETIC FIELD. V. P. Shavanskii (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1058-64(Apr. 1961). (In Russian)

The structure of the region of reflection of a plasma beam in a magnetic field and the structure of the transition layer between the stationary plasma and magnetic field are analyzed by applying the microscopic equations of motion of particles in self-consistent fields. In the first case corrections for polarization arising at a sufficiently high velocity of the incident beam are taken into account. (auth)

20287 QUANTUM THEORY OF THE EXCITATION SPECTRUM OF AN ELECTRON GAS IN A MAGNETIC FIELD. P. S. Zyryanov (Urals Polytechnic Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1065-71(Apr. 1961). (In Russian)

A quantum dispersion equation is derived for the longitudinal oscillations of an electron gas located in a magnetic field and possessing an arbitrary energy distribution func-

tion. The condition of applicability (with respect to the magnetic field) of the hydrodynamic approximation is found. It is shown that on changing from high magnetic field strengths to lower ones the longitudinal oscillation frequency varies in a discontinuous manner. The longitudinal dielectric constant of the plasma is calculated. (auth)

20288 STABILITY OF A PLASMA COLUMN WITH AN ANISOTROPIC PARTICLE VELOCITY DISTRIBUTION AND ARBITRARY CURRENT DISTRIBUTION. V. F. Aleksin and V. I. Yashin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1115-18(Apr. 1961). (In Russian)

The necessary conditions for stability of a plasma with an anisotropic distribution of particle velocities when it is located in a helical magnetic field are derived on the basis of kinetic theory without taking into account close encounters. (auth)

20289 ON MAGNETIC HYDRODYNAMICS FOR A NON-ISOTHERMAL PLASMA WITHOUT COLLISIONS. Yu. L. Klimontovich and V. P. Silin (Moscow State Univ. and Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1213-23(Apr. 1961). (In Russian)

Magnetic hydrodynamic equations for a plasma without collisions are considered. Dissipation due to absorption of magnetohydrodynamic and magnetoacoustic waves by electrons is taken into account. The equations derived are applied to analyze the smearing out of a packet in the plasma. It is demonstrated that under the conditions assumed when the spatial dimensions considerably exceed the Debye and Larmor ranges, stationary shock waves with a width much smaller than the mean free path length cannot exist. (auth)

20290 METHOD AND DEVICE OF POWER PRODUCTION BY NUCLEAR FISSION. J. G. Linhart (to C.E.R.N.). Belgian Patent 585,281.

A thermonuclear reactor is constituted by a flat cylinder, the walls of which are made of insulating material while the flat limiting surfaces are two circular electrodes connected to a pulsed high voltage source. A mixture of deuterium and tritium is introduced through apertures at the periphery of the cylinder. Inside the pressure is 10^{-6} mm of Hg. Both electrodes are energized at the same time and, due to the strong field thus produced, a cylindrical layer of ionized plasma contracts into an axial pinch of 1.5 to 2 mm diam. (EURATOM)

Shielding

20291 (KAPL-M-CHR-4) THE CENTRAL PROBLEM OF DISPERSION ANALYSIS. C. H. Randall (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 20, 1961. 24p. Contract W-31-109-Eng-52.

The performance of a dispersion material generally depends on its microstructure. In order to evaluate such sensitivity it is necessary to construct a mathematical model to describe the microstructure. A simple example of such a model is obtained by distributing particles of one phase randomly in cubic cells of another. As a consequence of this model, phase intercept distributions and neutron self shielding factors may be estimated. Another consequence of this model is a coarse but simple test for particle clumping. It can be shown that the probability of finding a w_0 by t_0 rectangular field, devoid of particles, on K, W by T, photomicrographs is P_0; if $P_0 \ll 1$ and

$$(w_0\, t_0) \cong \ln\left[\frac{-\mathrm{Ln}\,(1-P_0)}{\left(\frac{V}{\beta}\right)\left(\frac{WT\beta}{\overline{a}}+1\right)K}\right]\left[\left(\frac{\beta}{\overline{a}}\right)\mathrm{Ln}\left(1-\frac{V}{\beta}\right)\right]^{-1}$$

Here V is the particle volume fraction, β the areal packing factor and $\overline{a}$ the particle mean areal intercept. (auth)

20292 (NAA-SR-Memo-5948) SCARF 1 (SCATTERING CONTRIBUTION FROM AN ARRAY OF RADIATOR FINS): A FIRST ORDER APPROXIMATION OF THE SCATTERED FAST NEUTRON CURRENT FOR SNAP REACTOR SYSTEMS. C. A. Goetz and M. A. Boling (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 8, 1960. 38p.

A description is given of SCARF-1 which is a computational aid designed for application to shielding problems involving spacecraft powered by SNAP systems. Specific applications of the code are outlined. (B.O.G.)

20293 GRUNDZÜGE DER STRAHLENSCHUTZTECHNIK FÜR BAUINGENIEURE VERFAHRENSTECHNIKER, GESUNDHEITSINGENIEURE, PHYSIKER. (Outline of Radiation Shielding Techniques for Structural Engineers, Process Technicians, Health Engineers, and Physicists). Thomas Jaeger. Berlin, Springer-Verlag, 1960. 406p.

Radiation shielding is outlined for the engineer. Section titles are: Atomic Physics Fundamentals, Radiation Detection Instruments, Radiobiology Fundamentals, Gamma and Neutron Sources, Geometry of Sources, Experimental Arrangements for Reactor Shielding Measurements, Calculation of Gamma Attenuation, Calculation of Neutron Attenuation, Heat Generation by Radiation, Thermal Shielding of Reactors, Biological Shielding of Reactors, Design of Radioisotope Laboratories, Design of Separation Plants, Design of Technical and Medical Gamma Irradiation Facilities, Shielding of Particle Accelerators, Disposal of Radioactive Waste Materials from Nuclear Research and Nuclear Industry, Reactor Accidents and Their Consequences, and Safety Enclosures for Reactor Systems. (T.R.H.)

Theoretical Physics

20294 (CX-53) CORRELATION AND QUANTUM CORRECTIONS IN THE THOMAS-FERMI MODEL OF THE ATOM. Gene A. Baraff (New York Univ., New York. Inst. of Mathematical Sciences). Feb. 1961. Contracts AF19 (604)-4555; DA30-069-ORD-2581; Nonr-285(49); and NRO12-109. 40p. (AFCRL-TN-61-204)

A method is described for computing the effect of correlation, inhomogeneity, and exchange on the Thomas-Fermi model of the atom. The method makes use of the many body point of view, rather than an independent particle point of view, by considering the hierarchy equation linking the n-particle Green's functions. The hierarchy is truncated by a prescription equivalent to the Gell-Mann and Brueckner theory of the high-density electron gas, resulting in a description of the atom in which the exchange interaction is replaced by the effective interaction. The physical significance of this replacement is noted. The Green's function for this model is then expanded as a series in powers of $\hbar$. The lowest order term is found to describe the Thomas-Fermi model of the atom. The equation for the next higher term contributing to this expansion is manipulated so as to yield an ordinary differential equation for the corresponding correction to the potential. This equation contains a term which expresses the effect of inhomogeneity and another which arises from the correlation of the electrons and from exchange. The inhomogeneity term is one which was found previously. Study of the correlation term shows that it depends on the separation energy of an electron from an infinite electron gas, which suggests a generalization by which the method might be made applicable to the outer regions of the atom for which the electron density is below

that to which the Gell-Mann and Brueckner theory would apply. (auth)

20295 (NYO-9687) THE NATURE OF THE AXIOMS OF RELATIVISTIC QUANTUM FIELD THEORY. E. C. G. Sudarshan and K. Bardakci (Rochester, N. Y. Univ.). Apr. 26, 1961. Contract AT(30-1)-875. 15p.

The formulation of field theories by means of Wightman functions is studied. It is shown that, given two field theories that satisfy all the axioms, one can construct a family of Wightman fields with the same properties by a process of superposition of Wightman functions. The condition of unitarity is formulated without reference to asymptotic conditions, and it is proved that the Wightman fields constructed by the superposition process (starting with "unitary" fields) fail to preserve unitarity. (auth)

20296 (AEC-tr-3971(p.28-95)) THE METHOD OF FUNCTIONALS IN THE QUANTUM THEORY OF FIELDS. Yu. V. Novozhilov and A. V. Tulub. Translated from Uspekhi Fiz. Nauk, 61: No. 1, 53-102(1957).

The method of functionals in the quantum theory of fields is discussed. By this method equations for the field functions can be rigorously formulated and formal solutions obtained for the problem of interacting fields. Among the topics discussed are the following: the quantum theory of fields and functionals, the method of Fock functionals, the generating functional for amplitudes of the new Tamm-Dancoff method, the generating functionals for relativistic functions, the space-time treatment of the quantum theory and functionals, and the variation of the operator and functional integration in the case of a Fermi field. (M.C.G.)

20297 LOW-ENERGY PREDICTIONS OF MODIFIED YUKAWA POTENTIALS BETWEEN TWO NUCLEONS. D. B. Lichtenberg (Michigan State Univ., East Lansing). Am. J. Phys., 29: 357-64(June 1961).

Predictions of the Yukawa potential are reviewed. It is pointed out that the potential leads to qualitative, but not quantitative, agreement with two-nucleon experiments at low energy. The agreement can be made quantitative by making modifications of the Yukawa potential, for internucleon separations smaller than $\frac{1}{2}$ the Compton wavelength of the π meson. This result is illustrated with specific examples of modified potentials. The significance of these potentials is discussed. (auth)

20298 MULTICHANNEL EFFECTIVE RANGE THEORY. Marc H. Ross and Gordon L. Shaw (Indiana Univ., Bloomington). Ann. Phys. (N.Y.), 13: 147-86(May 1961).

Effective range theory is developed for systems of many coupled two-body channels with angular momenta l_i. Derivatives of the amplitudes M_{ij} (where M is essentially the inverse of the K matrix) are formed. In analogy with one-channel effective range theory, the diagonal elements M_{ii} are accurately given by an expression quadratic in the momentum k_i. The coefficients R_{ii} of k_i^2 are effective range type integrals which are interpretable in terms of the ranges of forces, and the R_{ii}'s can be taken to be energy independent to the same extent as in the one-channel theory. The non-diagonal elements M_{ij} are, to a good approximation, energy independent, even for R_{ii} greatly different from R_{jj} and $l_i \neq l_j$. The case of two coupled channels is studied in detail. A computer experiment is performed to test the validity of the theory; for $l = 0$, the properties of narrow resonances including the interactions which can lead to them are investigated. The positions of the poles of the T matrix are considered. Comparison is made between the effective range type of parametrization and Breit-Wigner theory. This theory is contrasted to the effective range theory for the eigenphase shifts; the eigenphase shift theory is shown, in principle, to be less accurate. Some possible applications are briefly discussed. (auth)

20299 A COMPLETE ORTHOGONAL EXPANSION FOR THE NUCLEAR THREE-BODY PROBLEM. PART I. ROTATIONAL FUNCTIONS. Roger E. Clapp (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N.Y.), 13: 187-236 (May 1961).

In the nuclear three-body problem, relativistic effects and noncentral forces mix states of different L and S but the same J. All sixteen of the states for $J = \frac{1}{2}$ are exhibited in an eight-component vector notation that displays all structural details in a compact spin-operator formulation. In addition, an abbreviated notation is introduced through which any state is characterized fully and clearly, showing its quartet or doublet character, its value of J and M_J, the particular vector, dyadic, or polyadic used in its construction if it is not an S state, and thereby its parity and L value. With this notation many simple operators (spin, derivative, permutation) act directly on the pertinent labels. More complicated operators (tensor, spin-orbit) can all be reduced to the simple operators and a set of twelve "primary scalar operators." The effect of each of the twelve primary operators on each of the sixteen rotational functions for $J = \frac{1}{2}$ is given as a set of twelve 16-by-16 matrices that can be combined by matrix multiplication to give the effect of the more complicated secondary operators. The procedure to be followed for $J = \frac{3}{2}$ and higher angular momenta is pointed out. Isospin functions are introduced, and the group-theoretical properties of the combined spin and isospin functions are examined. (auth)

20300 GAUGE INVARIANCE AND RENORMALIZATION CONSTANTS. L. Evans (Johns Hopkins Univ., Baltimore), G. Feldman and P. T. Matthews. Ann. Phys. (N.Y.), 13: 268-83(May 1961).

Using only general considerations such as translation invariance, positive definite energy spectrum, and gauge invariance, spectral representations are set up for the vacuum expectation values of two-photon and two-electron operators in electrodynamics. The gauge dependence of such quantities is thus clearly exhibited, particularly that of equal time commutators and of propagators. Certain constants related to the renormalization constants (integrals of the spectral functions) are defined and shown to be gauge invariant. The generalized Ward identity is established in any gauge. (auth)

20301 CONSERVATION LAWS IN GENERAL RELATIVITY. J. Rayski (Jagellonian Univ., Krakow and Inst. of Physics, Polish Academy of Sciences). Bull. acad. polon. sci., Sér. sci. math. astron. et phys., 9: 33-7(1961). (In English)

The general relativity conservation laws are formulated in the Riemannian geometry, in order that the Gauss-Ostrogradzki theorem might be applied. A tetrad field of vectors is introduced, by means of which any tensor of higher rank than four can be reduced to an equivalent set of vectors. This tetrad field is used to clarify concepts of energy-momentum currents, angular momentum currents, and flat space properties. (T.F.H.)

20302 EVALUATION OF THE PHASE SPACE INTEGRAL IN THE STATISTICAL TREATMENT OF MULTIPLE PRODUCTION WITH ANGULAR MOMENTUM CONSERVATION. R. Raczka (Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci.,

Sér. sci., math., astron. et phys., 9: 85-91(1961). (In English)

The usual Fermi statistical theory of multiple particle production gives only a very crude approximation of the effects of angular momentum. A formalism is reviewed in which angular and linear momentum, and one component of angular momentum, are good quantum numbers. The angular momentum effects are taken into account in this formalism. The probability $S_{N_1+N_2}$ for transition into a final state of N_1 nonrelativistic particles and N_2 relativistic particles is found. The cases of high-energy particle production and low-energy particle production are treated. (T.F.H.)

20303 ON GRAVITATIONAL RADIATION REACTION FORCES. A. Schild (Univ. of Texas, Austin and Univ. of London). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 105-6(1961). (In English)

A gravitational radiation reaction force m^2R^μ is proposed, analogous to the electrodynamic radiation reaction force e^2R^μ, in which m = mass and e = charge. The electrodynamic R^μ is tensorial. Under certain assumptions it is shown that the gravitational R^μ is not tensorial, and hence cannot have a physical interpretation. It is noted that, in these calculations, $R^\mu = 0$. (T.F.H.)

20304 PIONIC GAUGE. W. Krolikowski (Univ. of Warsaw). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 105-6(1961). (In English)

A pion gauge is developed, under which pion mesodynamics is invariant if the primary π-π interaction is ignored. This gauge is analogous to the electromagnetic gauge in electrodynamics. The special case in which the pion gauge yields the baryon gauge is noted. The pion mass properties are discussed with reference to the pion gauge. (T.F.H.)

20305 HYDRODYNAMIC STABILITY AND THE INVISCID LIMIT. K. M. Case (Univ. of Michigan, Ann Arbor). J. Fluid Mech., 10: 420-9(May 1961).

It is shown that for appropriate problems, the solutions of the linearized Navier-Stokes equations approach those of the linearized Euler equations as the viscosity tends to zero. (auth)

20306 A NOTE ON THE RELATIVISTIC BOLTZMANN EQUATION AND SOME APPLICATIONS. S. Yadavalli (Stanford Research Inst., Menlo Park, Calif.). J. Franklin Inst., 271: 368-75(May 1961).

Starting from the Boltzmann equation in the proper frame, the relativistic version of the Boltzmann equation in the absence of collisions is derived. As an application, a simple example of a velocity modulated drifting relativistic electron beam in the presence of a velocity distribution is treated. (auth)

20307 ENERGY, SPECIFIC HEAT, AND MAGNETIC PROPERTIES OF THE LOW-DENSITY ELECTRON GAS. W. J. Carr, Jr. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 122: 1437-46(June 1, 1961).

A perturbation expansion in powers of $r_s^{-1/4}$ is used to investigate the ground-state energy of a dilute electron gas, the result being, in rydberg units per particle, $E = -1.792/r_s + 2.66/r_s^{3/4} + b/r_s^2 + O(1/r_s^{3/2})$ + terms falling off exponentially with $r_s^{1/2}$. The dimensionless parameter r_s is the radius of the unit sphere in Bohr radii. The term in r_s^{-1} is the energy of a body-centered cubic lattice of electrons as calculated by Fuchs; the $r_s^{-3/4}$ term is the zero-point vibrational energy of the lattice, as obtained from a calculation of the normal modes, the result differing only by a small amount from the values estimated by Wigner; and br_s^{-2} is the first-order effect of anharmonicities in the vibration. The constant b is estimated, its magnitude being smaller than unity. The vibrational part of the specific heat is calculated, and a first-order approximation is obtained for the exponential terms in the energy. Part of this energy comes from exchange, which leads to the result that, except for very low densities ($r_s \gtrsim 270$), the electron spins are antiferromagnetically aligned. An order of magnitude for the Néel temperature is calculated. (auth)

20308 ONE-DIMENSIONAL ORDER-DISORDER MODEL WHICH APPROACHES A SECOND-ORDER PHASE TRANSITION. George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 122: 1477-84(June 1, 1961).

The calculation of the partition function for a simple one-dimensional order-disorder model is reduced to the solution of a certain functional equation. This equation is solved rigorously and it is shown that in the limit of indefinitely long-range interactions the model exhibits a finite discontinuity in the specific heat. (auth)

20309 TIME IN THE QUANTUM THEORY AND THE UNCERTAINTY RELATION FOR TIME AND ENERGY. Y. Aharonov and D. Bohm (H. H. Wills Physics Lab., Bristol, Eng.). Phys. Rev., 122: 1649-58(June 1, 1961).

Because time does not appear in Schrödinger's equation as an operator but only as a parameter, the time-energy uncertainty relation must be formulated in a special way. Various treatments of this problem are summarized. The main conclusion of these treatments, that in a measurement of energy carried out in a time interval Δt, there must be a minimum uncertainty in the transfer of energy to the observed system, given by $\Delta(E'-E) \geq h/\Delta t$ is criticized. It is shown that this conclusion is erroneous in two respects. First, it is not consistent with the general principles of the quantum theory, which require that all uncertainty relations be expressible in terms of the mathematical formalism, i.e., by means of operators, wave functions, etc. Secondly, the examples of measurement processes that were used to derive the above uncertainty relation are not general enough. A systematic presentation is given of the role of time in the quantum theory, and a concrete example is given of a measurement process not satisfying the above uncertainty relation. (auth)

20310 ON THE ASYMPTOTIC BEHAVIOR OF THE GREEN'S FUNCTIONS IN QUANTUM FIELD THEORY. V. P. Gachok (Inst. of Mathematics, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 879-84(Mar. 1961). (In Russian)

A correlation reduction principle in quantum field theory is proved which is analogous to the corresponding Bogolyubov principle in quantum statistics. The proof is performed by applying the technique of vacuum expectations of field operator products. By extending the results obtained to the Green's functions it has been possible to prove the Freese hypothesis regarding the asymptotic behavior of the Green's functions for the large space separations. (auth)

20311 ON ARBITRARY GAUGING OF THE ELECTROMAGNETIC POTENTIALS IN THE DISPERSION RELATION METHOD. V. D. Mur and V. D. Skarzhinskii (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1076-9(Apr. 1961). (In Russian)

The problem of arbitrary gauging of the electromagnetic potentials of quantum electrodynamics within the framework of the dispersion relation method is considered. A number of formulas are obtained which extends the well known relations. (auth)

20312 SUPERFLUIDITY IN A FERMI SYSTEM IN THE PRESENCE OF PAIRS WITH NONZERO ANGULAR MOMENTUM. L. P. Gor'kov and V. M. Galitskii (Inst. of Physics Problems, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1124-7(Apr. 1961). (In Russian)

A picture of the superconductive state in a Fermi system is proposed for the case when the Cooper pairs have a nonzero angular momentum. It is shown that if the system does not possess a total angular momentum, the ground state should be isotropic. The Fermi excitation spectrum has the usual form with an isotropic gap. (auth)

20313 ON THE THEORY OF LOCAL PERTURBATIONS IN LARGE SYSTEMS. V. I. Osherov (Karpov Inst. of Physics and Tech., USSR). Zhur. Eskptl'. i Teoret. Fiz., 40: 1166-71(Apr. 1961). (In Russian)

The energy shift of the ground state of a large Fermi system which occurs when a local perturbation is turned on is calculated with taking into account the interaction between the system particles. The levels of the localized state in this case smear out into bands. A condition for applicability of single particle approximations for description of states of this type is established. (auth)

20314 ON THE MAXIMAL CHARGE FOR A GIVEN MASS OF THE BOUND STATE. V. N. Gribov, Ya. B. Zel'dovich, and A. M. Perelomov. Zhur. Eksptl'. i Teoret Fiz., 40: 1190-8(Apr. 1961). (In Russian)

An elementary deduction based on application of the dispersion relations is presented for the Ruderman-Gazioro-wicz inequality, which restricts the charge. The maximal charge corresponds to the concept of a composite particle. A field theory nonrelativistic model is examined. It is shown that the physical (renormalized) charge approaches its maximal value upon infinite growth of the bare charge, the particle mass being fixed. Scattering in this case is consistent with the deuteron theory. In the same model involving an unstable particle, scattering tends to zero with infinite growth of the charge. (auth)

20315 MOMENTUM DISTRIBUTION OF PARTICLES IN A RAREFIED FERMI GAS. V. A. Belyakov (Moscow Engineering Physics Inst.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1210-12(Apr. 1961). (In Russian)

The first two terms in the gas parameter expansion of the momentum distribution of particles in a nonperfect Fermi gas are derived by perturbation theory methods. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

20316 (BAW-1186) GAS SUSPENSION COOLANT DEVELOPMENT PROJECT. SELECTION OF REACTOR SYSTEMS FOR STUDY OF THE APPLICATION OF GAS-GRAPHITE SUSPENSION COOLANT. W. K. Luckow, G. R. Thomas, and T. C. Helms (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Feb. 1960. Contract AT(30-1)-2316. 30p.

A survey of gas-cooled reactors was made for the purpose of selecting reactors best suited for an analysis of the effect of using gas-graphite suspensions as coolants. U. S., British, and French designs were considered. Reactors most amenable to improvement with this coolant are emphasized. The following properties can be utilized: improved heat transfer coefficient, improved heat capacity and heat transport, nuclear suitability of suspended graphite, compatibility of the graphite with most of the gases and materials used in gas cooled reactors, potential scavenger of fission, corrosion, and mass transfer products, and ease of varying effective density and heat capacity by variation of solids loading. The reactors recommended for study were further selected to be representative of existing or planned stationary and mobile designs. Selections encompass high and low pressure, temperature, and power density designs. Reactors subject to fission product leakage to the coolant are included. The following reactors have been recommended for concentrated study: ORNL Gas-Cooled Reactor (graphite moderated, He cooled, 2% enriched UO_2 1000°F, 300 psia); HTGR, Philadelphia Electric, Peach Bottom, Pa., (graphite moderated, He cooled, fully enriched UC, 1380°F, 294 psia); and Maritime Gas-Cooled Reactor (BeO moderated, He cooled, 5% enriched UO_2, 1000 psia, 1300°F). (auth)

20317 (CF-61-2-58) STATUS OF SMALL PIPE AND TUBE DISCONNECTS FOR MSRE AUXILIARY LINES. Interim Report. P. P. Holz (Oak Ridge National Lab., Tenn.). Feb. 21, 1961. 13p.

Three types of metal-to-metal seal disconnects were subjected to thermal cycling and make-break tests. In addition, a commercial disconnect was procured for testing. The two-bolt, spring-ring clamp joint appeared suitable for joints requiring constant leak detection or buffer monitoring. The single-seal, cone-seat disconnects with single-bolt loading appeared quite useful for sizes up to ¾ in. tubing but cannot be leak-detected. The bulky angle-valve type disconnects which include an open-position check valve appeared quite reliable; however, they were superseded by the smaller, cheaper, and simpler two block section units. Commercial disconnects on order are of the pushomatic design. (auth)

20318 (CF-61-3-75) FISSION PRODUCT TRANSPORT THROUGH GRAPHITE MATRICES. R. B. Korsmeyer (Oak Ridge National Lab., Tenn.). Mar. 21, 1961. 24p.

The transport of fission products from points of origin in unclad graphite matrix-type fuels to the reactor circulating system involves, as one of the steps, diffusion through the graphite matrix to the fuel element surface. As pointed out by Rosenthal, the fraction of a given fission product chain actually reaching the fuel element surface will be small if the time for transport through the graphite is long compared to the half-lives of the volatile members. An important problem, therefore, is the determination of the effective transport rates of the various mobile elements and their daughter products of interest through various graphites suitable for use as fuel element compacts, as functions of temperature over the range of greatest immediate interest to reactor designers. The upper end of the range need not exceed about 1000°C. The transport of helium and argon through various graphites has been the subject of considerable study by Watson, Evans, and others, and a preliminary investigation of the high temperature transport of some ordinarily non-volatile elements has been carried out by Saunders. This work is briefly reviewed in relation to the final problem and the areas in which further information is needed most by reactor designers is indicated. (auth)

20319 (CF-61-4-38) RE-EVALUATION OF THE ACTIVATED CHARCOAL FISSION GAS ADSORBER FOR THE LEAK DETECTION SYSTEM OF THE GC-ORR LOOP NO. 1. R. E. Adams and W. E. Browning, Jr. (Oak Ridge National Lab., Tenn.). Apr. 14, 1961. 7p.

The nitrogen leak-detection-system charcoal trap for the GC-ORR Loop No. 1 is re-evaluated under modified operating conditions and using recent laboratory data concerning the adsorption of krypton and xenon from very slowly moving gas streams. Under the new conditions the possible total-body radiation dose produced by atmospheric disposal of helium contaminated with fission products is calculated as 1.08 mr as compared to 0.55 mr reported originally. Even though the dose was increased by a factor of two, the consequences of atmospheric disposal of gaseous fission products from the experiment through the gas stack still do not appear serious. (For preceding report see CF-60-1-24.) (auth)

20320 (CF-61-5-62) XENON POISONING IN MOLTEN SALT REACTORS. J. W. Miller (Oak Ridge National Lab., Tenn.). May 3, 1961. 17p.

The xenon poison fraction in a 1000-mwe molten salt breeder reactor power plant (MSBR) was calculated as a function of sparging cycle-time and the rate of diffusion of xenon into graphitic structure in contact with the fuel salt. It was found that the xenon poison fraction can be held to 0.005 neutrons per neutron absorbed in fuel atoms by passing the fuel stream through a helium sparge-chamber at the rate of 10 ft^3/sec if the coefficient of diffusion is no greater than 10^{-7} cm^2/sec, or 21 ft^3/sec if it is as large as 10^{-5} cm^2/sec. (auth)

20321 (CNI-36) A MATHEMATICAL MODEL FOR STUDYING TRANSIENTS OF WATER MODERATED NUCLEAR REACTORS. L. Brusa and V. Macchi (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Nov. 1959. 68p.

A dynamic model for water moderated reactors is studied. The operational characteristics for no boiling, surface boiling, and bulk boiling are analyzed. The different heat transfer mechanisms involved in each of these cases are accounted for approximately. The model is used in the analysis of two transients of the Ispra-1 reactor. The kinetic equations are numerically integrated with a Runge-Kutto method, programmed for an IBM-650 computer. The stability of the system of kinetic equations is examined. (auth)

20322 (CRRP-1002) DIGITAL SIMULATION OF XENON INSTABILITY IN REACTORS. W. M. Barss (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1961. 78p. (AECL-1226)

A digital computer was made to simulate the behavior of a reactor by computing alternately a one-group two-dimensional neutron flux distribution for a buckling dependent on the instantaneous xenon distribution and a new xenon distribution, assuming that the flux remains unchanged for an interval of the order of 1 hr. Oscillations in these distributions may be induced, if they do not occur spontaneously, and the threshold for undamped oscillations may be predicted from the rates of growth or decay of oscillations produced under two or more sets of conditions. The oscillation threshold determined in this way for a uniform rectangular reactor was compared with the threshold determined analytically by a linearized perturbation method. The computer method has some advantages for simulating arbitrary spatial variations in the fission yield of xenon and in the buckling in both core and reflector, and for portraying local flux disturbances due to fuel changes. Computing time was reduced by exciting an oscillation free of higher modes and by calculating the xenon distribution at intervals of about three times the xenon relaxation time, then correcting the apparent oscillation decay constant for the finite interval. For a 100-point mesh, a decay constant determination requires about 45 minutes on the Datatron computer. The computer method was used to predict the behavior of the CANDU power reactor, as a check on earlier analytical studies. This reactor, which uses natural uranium oxide fuel with heavy water as both moderator and primary coolant, is designed for a thermal power output of approximately 700 MW. The results indicated that xenon instability would be an operating problem if the reactor were not stabilized by the power coefficient of reactivity; this coefficient is negative for CANDU because the low thermal conductivity of the oxide leads to high fuel temperatures at which the Doppler effect is predominant. (auth)

20323 (GA-2125) RELATION OF CRYSTAL SYMMETRY IN GRAPHITE TO LATTICE VIBRATIONS AND THEIR INTERACTION WITH SLOW NEUTRONS. Donald E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 15, 1961. Contract AT(04-3)-314. 23p.

By considering the symmetry properties of a crystal, the symmetry properties of quantities defined in the reciprocal lattice space can be deduced. Relations are obtained for the frequencies and polarization vectors of phonons with propogation vector $\vec{q}$. The results are then applied to the formal study of the interaction of slow neutrons with the lattice vibrations in graphite. If the coupling forces between the principal planes of the graphite crystal are weak compared with intraplanar forces, and if interference effects are neglected, then the frequency distribution function associated with vibrations parallel and perpendicular to the principal planes is sufficient to describe the interaction of neutrons with the lattice. (auth)

20324 (HW-67000) PLUTONIUM RECYCLE PROGRAM ANNUAL REPORT, FISCAL YEAR 1960. J. M. Atwood and W. A. Snyder, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 15, 1960. Contract AT(45-1)-1350. 89p.

Four computer codes were developed to investigate reactor physics parameters in terms of over-all fuel cycle economics. Work was continued on the generalized evaluation of self-sustaining plutonium recycle in enriched thermal reactors. Calculations of fuel costs were made for a reactor operating on plutonium recycle without plutonium sale, and for once-through operation and sale of plutonium. The relative worth of the several plutonium isotopes in a given reactor environment was determined using the Meleager code. Planning and scheduling of basic PRTR fuel loadings were continued to assure maximum contributions of the reactor to the over-all program. Measurements were completed on the fission cross section of Pu^{241} over the neutron energy region of 0.1 to 20 ev. The subthreshold fission cross sections of U^{234}, U^{236}, U^{238}, and Pa^{231} were also determined. Critical approach and exponential experiments were conducted with Al–5 wt.% Pu fuel elements in light water to provide critical mass data. Fuel rods for 30 Pu–Al spike enrichment elements were fabricated. Extensive corrosion testing of various Ru–Al alloys was performed. Sinterability characteristics, melting curves, thermal expansion, and thermal conductivity of PuO_2, UO_2, and mixtures of the two were determined. Hot swaging and vibratory compaction techniques were investigated. Ultrasonic, eddy current, fluorescent dye penetrant, and radiographic tests verified the high metallurgical integrity of the Zircaloy-2 tubes. Evaluation of Zircaloy-4 was carried out to determine its corrosion resistance and hydriding characteristics. Fretting corrosion of Zircaloy-2 components was investigated. Al alloys containing 1 to 2% each of Fe and Ni showed improved corrosion resistance over the more standard X-8001 alloy in 360°C water. Preliminary design was completed on the Plutonium Recycle Critical Facility, to be located adjacent to PRTR. Research and development continued on chemical processes for economical separation and decontamination of plutonium and uranium from spent fuels. Work was continued on design of equipment for decontaminating plutonium by ion exchange. (M.C.G.)

20325 (HW-67777) VIBRATIONALLY COMPACTED CERAMIC FUELS. J. J. Hauth (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 10, 1961. Contract AT(45-1)-1350. 39p.

Progress is reviewed in studies of vibrationally compacted and other particle-containing ceramic fuel elements. Included are details of the equipment and techniques for the vibrational compaction process developed at Hanford. This process has been applied to fuel elements of various geometries, comprising several types of core and cladding materials. With proper control of process variables, uniform densities greater than 90% of theoretical density are routinely achieved. Information is also provided regarding nondestructive testing and in-reactor irradiation studies. Fuel elements evaluated thus far demonstrated high integrity, excellent stability, and adequate fission gas retention under extreme operating conditions. One of the most interesting applications for vibrationally compacted fuels is in plutonium fuel cycles, in which plutonium may supplement as well as supplant enriched uranium. The application of vibrational compaction to partially decontaminated recycled fuel is also described, and areas for future work are outlined. (auth)

20326 (HW-68773) FINAL DESIGN REPORT, DR-1 GAS LOOP. R. E. Baars (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 85p.

The DR-1 Gas Loop is an in-reactor test facility that was designed, built, and is now operating in a Hanford production reactor. The facility is devoted to tests of fuel elements and materials of interest in the gas-cooled reactor program. The facility operates with either helium or nitrogen as coolant at a maximum pressure of 215 psig. Fuel element powers of 50 kw can be accommodated. Gas flow rates of 450 lb/hr helium or 2000 lb/hr nitrogen can be delivered with test specimen pressure drops of four psi and 10 psi, respectively, at the flow rates. Specimen outlet-

gas temperatures of 1250°F can be accommodated; under some circumstances, higher temperatures are permissible. For the most part, the loop was designed within existing technology. However, the compressors are unique, using gas-lubricated bearings. This feature eliminates lubricant contamination and rotating gas seals. (auth)

20327 (IDO-16640) SPERT PROJECT QUARTERLY TECHNICAL REPORT, APRIL, MAY, JUNE, 1960. Frank Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 7, 1961. Contract AT(10-1)-205. 37p.

SPERT I. The experimental program for kinetic testing of the ORNL Bulk Shielding Reactor BSR-II core was completed. The prompt neutron lifetime parameter $1/\beta_{eff}$ for the BSR-II core was determined by analysis of data from approximately 40 super-prompt-critical power excursions. The dynamic measurements were compared with those obtained from 1/v-absorber, reactor noise, and pulsed neutron measurements. The results from the various techniques agreed within the assigned experimental errors. The previously tested "P" core was reinserted in Spert I for use as the driving source for the in-pile capsule studies of transient steam void formation. Prior to the initiation of the capsule program, a series of low-power, large-amplitude, reactivity oscillation measurements was performed to supplement an earlier series of low- and high-power transfer function measurements performed on the P-18/19 core. SPERT II. The intrinsic neutron source level was measured for three different light-water-moderated, highly enriched, uranium-aluminum plate-type cores in Spert II. The level was found to be approximately 3.6×10^{-1} neutrons per sec per g of U^{235}, in good agreement with calculated values attributed primarily to the $Al(\alpha,n)P$ reaction where the alpha particles are supplied by the U^{234} content of the fuel. Measurements were made in Spert II of the statistical fluctuation of the neutron flux at very low-power levels for two cores at various subcritical multiplications. The differential control rod worths, temperature coefficients and pressure coefficients were determined for a light-water-moderated core containing an excess reactivity of about $6 at ambient temperature and atmospheric pressure. SPERT III. The first series of self-limiting power excursion tests was performed in the Spert III reactor to provide a base point for additional investigations of the effect of various system parameters on the kinetic behavior of the system and to provide a basis for comparison of the behavior of the Spert III core with that of the several cores previously tested in Spert I. This fiducial test series included power excursions with initial asymptotic periods from 10 sec to 10 msec initiated from room temperature, at atmospheric pressure, and with no forced coolant flow. As expected, the performance of the Spert III core was quite similar to that of the other cores. An additional test series was performed to investigate the effect of system pressure on power excursions initiated from room temperature. For short-period excursions, as the pressure was raised from 0 to 2500 psig, the delay and eventual suppression of boiling as a shutdown mechanism caused approximately a two-fold increase in energy release and fuel-plate temperature rise with a resultant increase in the reactivity compensation arising from water and fuel plate expansion. The power burst was broadened slightly with only a small increase in the power maximum. ENGINEERING. Preliminary burnout heat flux calculations were made on the Spert III reactor core to help establish operational limits for the steady power experiments. As a first approximation, an IBM-650 computer program was coded to calculate the burnout conditions in the high temperature (400 to 650°F) high pressure (2000 to 2500 psig) range. For simplicity, two-phase flow effects were neglected. However, a sample calculation showed burnout heat fluxes to be in the bulk boiling region for some of the operational ranges investigated. Out-of-pile hydraulic tests were conducted on a Spert III type "C" 1-S fuel assembly in a flow jig simulating the condition of a typical position in the Spert III reactor core. A pitot tube located in a position hydraulically similar to one used for the Spert III reactor engineering hydraulic tests was calibrated to establish the geometric correlation coefficient. This coefficient was found to be 1.073 ± 0.005 which compares favorably with the value of 1.0 which was assumed for the initial evaluation of the engineering hydraulic test data. The initial handling procedures used for charging the Spert II reactor system with heavy water are described and a summary of the major mechanical design efforts for the quarter is presented. ANALYSIS. Three computer programs were written in order to expedite the reduction and analysis of data obtained from the various experimental programs. These programs are briefly described. (auth)

20328 (NAA-SR-Memo-5701) ADVANCED ONCE-THROUGH STEAM GENERATOR FOR SODIUM APPLICATION. G. R. Terpe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 19, 1960. 23p.

Preliminary design calculations were performed for a once-through type steam generator and reheater for advanced sodium power plants in the 300-Mwe range. Parameters and performance data are presented. (D.L.C.)

20329 (NAA-SR-Memo-5982) SHAPE OF A MINIMUM WEIGHT REFLECTOR. C. M. Podeweltz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 20, 1960. 12p.

The possibility of reducing the weight of SNAP radial reflectors while keeping their reactivity worth constant by varying their shape is analyzed in terms of reactivity weighting functions for the axial and radial directions. The results are applied to the specific case of the SER (SNAP-2); a weight reduction of 12% is obtained. (D.L.C.)

20330 (NUMEC-P-28) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. MONTHLY PROGRESS LETTER FOR PERIOD MAY 1 THROUGH MAY 31, 1961. H. J. Garber (Nuclear Materials and Equipment Corp., Apollo, Penna.). June 5, 1961. Contract AT(30-1)-2389. 7p.

When loaded with plutonium, reactor behavior was determined for the SM-1 and a burner reactor core composed of Shippingport seed fuel elements. Results showed that long core life is attainable with only nominal shim control requirements and that the moderator temperature coefficient of reactivity is strongly negative throughout core life. PuO_2 and PuO_2-UO_2 fuels are being prepared by a continuous precipitation method. Surface area measurements on PuO_2 powder derived from Pu(IV) oxalate indicated an apparent increase in specific surface with time in storage. The four-module glove-box system which will enclose the reprocessing complex passed leak test requirements. Pellets were pressed from UO_2, PuO_2, 0.5 wt.% $PuO_2-95.5$ wt.% UO_2, and 20 wt.% PuO_2-80 wt.% UO_2 without the use of binder additives and sintered. The contaminated maintenance machine shop glove-box was essentially completed. Techniques were developed for the metallographic preparation and chemical etching of UO_2, PuO_2, and 20 wt.% PuO_2-80 wt.% UO_2. Spherical UO_2 was prepared by the use of a plasma torch. (M.C.G.)

20331 (TID-7522(Del.)) FUEL ELEMENT TECHNOLOGY PAPERS PRESENTED AT THE CONFERENCE

IN CINCINNATI, OHIO, ON JUNE 19 AND 20, 1956. Calvin Davis, comp. (Atomic Industrial Forum, Inc., New York). Aug. 1956. Decl. with deletions Jan. 27, 1960. 255p.

Papers were presented on the importance of fuel technology to the development of reactors, preparation of fuel element cores, preparation of U and U alloy powder compacts, fabrication and processing UO_2 elements, reduction, melting and fabrication of metallic Th, and fabrication and cladding of Pu-containing cores. Other papers were presented on fabrication of composite fuel plates by roll cladding, co-extrusion of nuclear fuel elements, and pressure bond cladding. Presentations by industrial representatives on nuclear products available at various companies are also included. (J.R.D.)

20332 (TID-11912) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report, December 15, 1960 to February 15, 1961. (Sargent and Lundy, Chicago). Feb. 23, 1961. For Armour Research Foundation. Contract AT(11-1)938. 71p. (SL-1857-2)

A progress report is presented on the evaluation of three sizes of reactor plants (44, 180, and 300 Mwe) for four containment concepts (standard steel pressure vessel, Canadian NPD-2 type, Humboldt Bay pressure suppression type, and BONUS type). Containment design calculations were completed for standard containment and BONUS schemes, and radiation dosage calculations were also completed for standard containment and Canadian NPD-2 schemes. Design work which was completed include the 300-Mwe flow diagram; 300-Mwe standard containment arrangement; 44-, 180-, and 300-Mwe NPD-2 containment arrangement; and 44-Mwe BONUS arrangement. (D.L.C.)

20333 (TID-12765) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report; February 15, 1961—April 15, 1961. (Sargent and Lundy, Chicago). Apr. 25, 1961. For Armour Research Foundation. Contract AT(11-1)-938. 15p. (SL-1857-3)

Progress in the preparation of an economic and technical feasibility study of various containment schemes is reported. All design calculations, general arrangements, and estimating were completed for three reactor plants (44 MWe, 180 MWe, and 300 MWe) incorporating the following containment concepts: standard steel pressure vessel, pressure relief, pressure suppression, and low pressure. Some preliminary investigations were also made of a high-pressure hot water storage vessel and of methods for heating water. (M.C.G.)

20334 (WAPD-TM-280) ISOTOPIC ANALYSES OF IRRADIATED NATURAL URANIUM DIOXIDE FUEL RODS FROM PWR CORE 1—PRELIMINARY RESULTS. C. D. Sphar, J. H. Leonard, and P. S. Lacy (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1961. Contract AT-11-1-GEN-14. 32p.

During the first seed refueling of PWR Core 1, a number of natural UO_2 fuel elements were removed from the blanket region of the core and destructively analyzed for their U and Pu isotopic content. The experimental data thus obtained are compared with theoretical results calculated using current fuel depletion techniques. Experimental results for the ten fuel elements selected for study indicate that re-analysis is necessary to obtain improved measurement of some of the quantities of interest. That part of the present data which is believed reliable is used to provide a preliminary evaluation of current fuel depletion methods. (auth)

20335 (CEA-tr-A-919) L'EFFICACITE DES BARRES DE SECURITE DE REACTEURS THERMIQUES, COMPTE TENU DE LEUR DIAMETRE, LEUR NOMBRE ET LEUR DISPOSITION. (The Effectiveness of Safety Rods of Thermal Reactors, Calculations of Their Diameter, Their Number, and Their Arrangement). W. Hafele (Max-Planck-Institut für Physik, Gottingen). Translated into French from Report No. 8. [1957]. 58p.

A calculation is made of the variation of safety-rod effectiveness with the number and diameter. One-group theory is used for the case of a cylindrical reactor with the rod passing completely through the reactor. An eccentric rod is first considered, then 4 rods arranged symmetrically, more than 4 rods, arrangements with lesser symmetry, and 2×2 and 2×4 rods. Calculations are then made for K-1 variation for insertion of safety rods. Numerical values are given graphically. (T.R.H.)

20336 SITE SELECTION AND MAXIMUM ASSUMABLE ACCIDENT IN REACTOR PLANTS. E. Stauber (AEG-Kernenergieanlagen, Frankfurt am Main). Atomkernenergie, 6: 165-70(Apr. 1961). (In German)

When selecting the site for a reactor, the effects of the maximum credible accident must be considered. Based on a safe and realistic evaluation of the accidental effects, a procedure for evaluating the safety of the location is given. The necessary fundamentals for calculating the radioactive exposure of human persons take into consideration, in the comprehensive form stated, the time-depending release of radio-active materials after the accident. (auth)

20337 THE STRESSED CONCRETE PRESSURE CONTAINERS OF THE G-2 REACTOR. L. Maillard (Commissariat à l'Energie Atomique, Paris). Atomwirtschaft, 6: 233-8(Apr. 1961). (In German)

Experience gained in the construction and use of stressed concrete pressure containers for the G-2 and G-3 reactors has fulfilled expectations with respect to construction and operating characteristics. Difficulties connected with the stressing of the cables and cooling were resolved either by preliminary trials or by the erection of the G-2. Destructive tests on models were made to test pressure characteristics. (auth)

20338 CATCHING BURST SLUGS. Engineering, 191: 599-600(Apr. 28, 1961).

Systems for detecting burst slugs in gas cooled reactors are described. A coarse scanning unit periodically monitors a number of fuel channels for fast bursts, and a fine scanning unit periodically monitors single channels for slow bursts. The coolant gas is filtered to remove solid matter, then electrostatically precipitated onto a section of wire. The activity from the coolant itself is decreased by the precipitation. The final activity of the wire indicates the presence or absence of burst slugs. The Windscale AGR continuous burst detection system is described. The use of these systems in water cooled reactors is discussed. (T.F.H.)

20339 ROLE OF CRITICAL EXPERIMENT IN REACTOR DEVELOPMENT. Eizaburo Nishibori and Kazuhiko Inoue (Atomic Energy Research Inst., Tokyo). Genshiryoku Hatsuden, 4: No. 3-4, 72-5(1960). (In Japanese)

Critical assemblies are used for: a) reactor design studies, b) determination of the safety limits in the handling of nuclear fuel elements, and c) for basic research in reactor physics. Exponential, sub-critical, critical and zero-power experiments are described, giving examples from abroad, such as ZPR-III, Aquilon, Bettis Laboratory tests, Proserpine, UCRL experiments, LASL facilities, the Yugoslav experiments, FRP and PTR. Accidents in critical assemblies are discussed, deriving from the general rules for safe operation. The semi-homogeneous experiment

SHE), currently underway at JAERI, is described, listing data on high-temperature operation, high conversion ratio and handling methods. The fuel consists of UO_2 + C or ThO_2 + C in the form of 10-mm thick discs homogeneously dispersed in a graphite matrix. The operational procedure, control system, safety considerations, and fuel element loading are discussed. The aqueous homogeneous critical assembly, planned since 1958 for JAERI is described: it is a thermal breeder with a high breeding ratio and low fuel inventory, operating on the Th–U^{233} cycle with the following characteristics: thermal power–10 w; continuous operation, 3 hrs; thermal flux (core), $5 \cdot 10^6$ to 10^7 n/cm^2-sec; core temperature, 15 to 30°C; fuel, 20% enriched U; core, 2 kg U^{235} + D_2O; blanket, 2 tons of ThO_2 slurry; total D_2O, 3 tons. The Fast Breeder Reactor (FBR) is planned for construction between 1960 and 1970 at JAERI. First, however, a fast neutron spectroscopy using a pulsed neutron technique will be developed. The Blanket Exponential Experiment (BEE) will have 2.3 kg of natural uranium as fuel in form of rods. During the early stages 3 kg of U^{235} converter will be used as a fast neutron source. The subcritical assembly of Tokyo University uses 2 tons of natural uranium in form of UO_2; it includes also a pulsed neutron source. The exponential and subcritical assembly of the Tokyo Institute of Technology consists of 2.5 tons of natural uranium, light water, and graphite. The subcritical assembly of the Mitsubishi Atomic Power Industries, Inc. consists of 2.0 tons of natural U and light water, combined with a Cockcroft-Walton neutron source. The Fuji Electric Mfg. Co.'s critical assembly contains 1.8 tons of natural metallic U, 22 tons of graphite on a graphite pedestal and will be used to obtain experimental data for a Calder Hall type reactor and the TOKAI power reactor. (TTT)

20340 CALCULATIONS OF FUEL-ROD TEMPERATURES IN NUCLEAR REACTORS AT TRANSIENT OPERATION. V. S. Ermakov, I. P. Zhuk, and O. I. Yaroshevich (Inst. of Power Engineering, Academy of Sciences, BSSR, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: 104-8(Jan. 1961). (In Russian)

By the method of finite integral transforms the problem of temperature distribution in fuel elements of a water-moderated water-cooled reactor in transient conditions is solved. Results of analytical calculations are compared with data obtained on the hydraulic analog computer. (auth)

20341 SCHEME FOR BURN-UP CALCULATIONS. IV. EXCHANGE OF THE FUEL FROM THE AXIS TO THE BOUNDARY OF A CYLINDRICAL REACTOR OF FINITE HEIGHT. K. Meyer (Wissenschaftlich-Technisches Büro für Reaktorbau, Berlin-Pankow, Ger.). Kernenergie, 4: 101-5(Feb. 1961). (In German)

The burn-up after the transfer of the fuel rods from the axis to the perimeter of a reactor of finite height is calculated. The discrete transfer pattern through a continuous passage of the fuel was approximated. The one-group theory was used. It was assumed that k_∞ is linearly dependent on the thermal neutron flux. Expressions for the maximum and mean burn-up depth and estimations of the neutron flux inhomogeneities to be expected are derived. (J.S.R.)

20342 SAFETY AND SERVICEABILITY IN REACTOR SAFETY CIRCUITS—1. U. Broccardo (Kennedy and Donkin). Nuclear Power, 6: No. 62, 67-9(June 1961).

The statistical aspects of reactor safety circuitry are outlined. The financial requirements of serviceability are balanced against safety requirements. Statistical methods for attaining the condition in which a spurious trip will most probably not occur, but in which unsafe conditions will most probably initiate a trip, are given. (T.F.H.)

20343 REACTIVITY EFFECTS OF PROTACTINIUM-233 BUILDUP IN U^{233} FAST BREEDER REACTORS. Arthur J. Goldman (Nuclear Development Corp. of America, White Plains, N. Y.). Nuclear Sci. and Eng., 10: 91-2(May 1961).

The effects of Pa^{233} production in U^{233} fast breeder reactors are studied. The Pa^{233} is formed by the reaction $Th^{232}(n,\gamma)Th^{233} \rightarrow \beta^- + Pa^{233}$; it decays by the reaction $Pa^{233} \rightarrow \beta^- + U^{233}$. In a reactor using U–Th fuel elements, the reactivity during shutdown increases because of the 27-day decay of Pa^{233}. An example is given. The excess reactivity effects are functions of bred fuel atom distributions and of fuel reactivity worth. (T.F.H.)

20344 THE APPLICATION OF STATISTICAL METHODS OF ANALYSIS FOR PREDICTING BURNOUT HEAT FLUX. W. R. Gambill (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 10: 92(May 1961).

A discussion is given concerning a statistical method for predicting burnout heat flux. Examples are given to show that a pressure effect implied by the method is spurious. It is noted that the resulting flux prediction is given as a small difference between two large numbers; the accuracy of the result is thus reduced. It is shown that a diameter effect arising from the prediction equation lacks substantiation, and that the predictions are invalid for rectangular channels. The efficacy of the method in bulk-boiling burnout is questioned. (T.F.H.)

20345 THE APPLICATION OF STATISTICAL METHODS OF ANALYSIS FOR PREDICTING BURNOUT HEAT FLUX—REBUTTAL. R. T. Jacobs and J. A. Merrill (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 10: 92-3(May 1961).

A discussion is given concerning a statistical method for predicting burnout heat flux. Pressure, statistical, and fuel element-channel gap effects that are implicit in the analysis are reviewed. It is noted that the method is valid only for cylindrical channels, and that the analysis is applicable to the bulk-boiling region. The statistical, rather than physical, nature of the method is noted. (T.F.H.)

20346 PREDICTING BURNUP OF STAINLESS STEEL–UO_2 CERMET FUELS. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 19: No. 6, 45-8 (June 1961).

The burnup of stainless steel (SS)-UO_2 cermet fuel elements is studied between 200 and 1800°F. The fuel elements studied are either plates or pins, consisting of a stainless steel-UO_2 dispersion core and a bonded stainless-steel outer layer. Effects of irradiation, at.% U^{235} in dispersion, structural imperfections, and UO_2 particle growth under irradiation are outlined. In particular, techniques are described for reducing the inhomogeneity in UO_2 loading, which is encountered in rolled fuel plates. (T.F.H.)

20347 DEVICE FOR THE INDIVIDUAL CONTROL OF THE FLOW RATE OF THE COOLANT THROUGH THE CHANNELS OF A NUCLEAR REACTOR. R. Martin (to C.E.A.). Belgian Patent 574,428. Priority date, Jan. 20, 1958.

Each fuel channel is fitted with a regulating diaphragm. If a fault, due to the diaphragm, develops in a channel, a device, controlled from outside the reactor core, can remove the faulty diaphragm and insert a new one, provided the reactor load is reduced by ~ 50%. (EURATOM)

20348 FUEL ELEMENT STRUCTURE FOR NUCLEAR REACTORS. M. Salesse and J. Stohr (to C.E.A.). Belgian Patent 574,484. Priority date, Jan. 15, 1958.

Each element is a cluster of canned rods which are interconnected by strips of the same metal to ensure even distribution of temperature. Several different geometries are proposed. (EURATOM)

20349 NEW ARRANGEMENT OF CONTROL RODS IN A NUCLEAR REACTOR. J. Weill (to C.E.A.). Belgian Patent 574,811. Priority date, Jan. 29, 1958.

The structures of the fuel elements and of the control rods are so arranged that with a very small displacement of the latter (1 to 2 in.) the reactivity can vary from a maximum value to nil. The displacement can be a translation or a rotation. (EURATOM)

20350 REMOTE MEASUREMENT OF THE DISPLACEMENT OF AN INACCESSIBLE PART. P. Rouge (to C.E.A.). Belgian Patent 575,942. Priority date, Feb. 17, 1958.

The device is used mainly in the measurement of changes in the structure of a moderator due to Wigner growth. A spring is inserted between the moderator and a piston; the piston is balanced by pressure exerted through bellows, the other end of which rests on the pressure vessel of the reactor. A pointer moves with the piston between two pre-set electric contacts. The difference in pressure applied to the bellows to move the pointer between the contacts indicates, by comparison to a reference, the motion of the moderator. (EURATOM)

20351 LEAKPROOF ASSEMBLY OF MODERATOR BLOCKS IN A NUCLEAR REACTOR. G. Lemesle and P. Rouge (to C.E.A.). Belgian Patent 576,423. Priority date, Mar. 15, 1958.

The moderator blocks are separated by a flat ring made of the same moderating material and machined so that its minimum Wigner growth applies perpendicularly to its flat surfaces. Corresponding grooves are cut into the ends of the blocks. (EURATOM)

20352 SHIELD FOR NEUTRON PROBE. (to Siemens-Schuckertwerke). Belgian Patent 576,529. Priority date, Mar. 14, 1958.

The initial patent, No. 572,809 (Belgium), provided for surrounding the neutron probes used in nuclear reactors with successive layers of moderator, reflector, and neutron absorber. Now, a layer of fissionable material is introduced in front of the probe, for instance a uranium plate. The number of fast neutrons emitted by this plate is proportional to the thermal neutron flux to be measured. (EURATOM)

20353 IMPROVED NUCLEAR ENERGY REACTOR STRUCTURE. John Douglas Hay (to Robert McAlpine & Sons, Ltd.). British Patent 866,037. Apr. 26, 1961.

A reactor structure wherein the heat exchangers or boilers are located in a space between primary and secondary biological shielding wall surrounding the closed reactor space is described. The reactor vessel is constituted by a closed inner chamber formed of concrete and surrounded by one or more closed chambers bounded by the concrete wall of the inner chamber and concrete surrounding the wall of the inner chamber. Passages are provided in the wall of the inner chamber for the circulation of a coolant between the chambers, and inlet and outlet passages are provided in the concrete for a driving fluid which is to receive heat from the coolant. (N.W.R.)

20354 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Atomic Power Constructions, Ltd. and International Combustion (Holdings), Ltd.). British Patent 867,241. May 3, 1961.

A nuclear power reactor is described. It consists of an arrangement of tubes wherein fissile fuel elements (uranium alloy, ceramic uranium compound, or uranium cermet) are located. The liquid moderator contained in a vessel and located around the tubes is either light or heavy water. The vapor coolant circuit is located outside the moderator vessel and is made up of light or heavy water steam. In operation, moderator vapor is circulated through the closed circuit to remove the heat. The tube assemblies are adapted to fit together and may be withdrawn for servicing. (N.W.R.)

20355 IMPROVEMENTS RELATING TO FUEL ELEMENT CHARGING APPARATUS FOR GAS COOLED NUCLEAR REACTORS. Donald Mason Sutherland and Philip Rawson Tipper (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 868,021. May 17, 1961.

Apparatus for transferring fuel elements between a container located outside a gas cooled reactor and fuel element channels within the core of the reactor is described. The apparatus consists of a chute adapted to extend from the container into the pressure vessel of the reactor, a gas tight controlled tubular duct flexible over part of its length and adapted to extend radially out from within the lower end of the chute, and means for aligning the lower end of the tubular duct with the end of a selected fuel element channel and for making a substantially gas tight coupling between the lower end of the tubular duct and the channel. (N.W.R.)

20356 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Leslie Clunn (to Hawker Siddeley Nuclear Power Co., Ltd.). British Patent 868,318 May 17, 1961.

A CO_2 cooled D_2O moderated reactor is described. A continuous circuit is provided for passing D_2O through the irradiation zone. An extension from the circuit has means for supplying CO_2 during operation under pressure to the surface of D_2O in the extension, means for withdrawing water from the extension, and means for passing the removed D_2O to a distillation column for extraction of dissolved CO_2 and radiolysis products. The extension also provides for returning the CO_2 and D_2O from the extraction column to the reactor. (N.W.R.)

20357 "ON-LOAD" LOADING OF FUEL ELEMENTS IN HETEROGENEOUS REACTORS. W. Beck (to Siemens-Schuckertwerke). German Patent DAS 1 095 413. Dec. 22, 1960.

The method is adapted from the well-known Canadian cross-feeding system. Two loading machines positioned, one above and the other below the core of the reactor, unload and load two channels simultaneously, one from the top, the elements sliding downwards, the other from the bottom, the elements being pushed upwards. Drum type magazines are used on the machines for both new and spent fuel elements. (EURATOM)

20358 OPERATION OF A REACTOR. A. Miller (to Deutsche Babcock & Wilcox). German Patent DAS 1 097 050. Jan. 12, 1961.

In order to lower the number of loading and unloading operations of a reactor, and increase its continuous time of operation, provision is made for restricting the fission process to certain zones. This enables spent fuel to remain inside the reactor until its radioactivity is low enough and, or, loading fertile material together with fissionable material, "switching over" to the former when it has become fissionable. A larger core than in conventional reactors is necessary. (EURATOM)

20359 METHOD AND APPARATUS FOR REACTOR SAFETY CONTROL. Norman E. Huston (to U. S. Atomic Energy Commission). U. S. Patent 2,987,455. June 6, 1961.

A self-contained nuclear reactor fuse controlled device

which comprises broadly a closed shell containing a neutron absorbing material, normally in a compact form but which can be expanded into an extended form presenting a large surface for neutron absorption when triggered by an increase in neutron flux, is described.

20360 TWISTED RIBBON FUEL ELEMENT. Calvin R. Breden and Arthur B. Schultz (to U. S. Atomic Energy Commission). U. S. Patent 2,987,458. June 6, 1961.

A reactor core formed of bundles of parallel fuel elements in the form of ribbons is patented. The fuel ribbons are twisted about their axes so as to have contact with one another at regions spaced lengthwise of the ribbons and to be out of contact with one another at locations between these spaced regions. The contact between the ribbons is sufficient to allow them to be held together in a stable bundle in a containing tube without intermediate support, while permitting enough space between the ribbon for coolant flowing.

20361 PRESSURE SYSTEM CONTROL. Walter H. Esselman and George M. Kaplan (to U. S. Atomic Energy Commission). U. S. Patent 2,989,453. June 20, 1961.

The control of pressure in pressurized liquid systems, especially a pressurized liquid reactor system, may be achieved by providing a bias circuit or loop across a closed loop having a flow restriction means in the form of an orifice, a storage tank, and a pump connected in series. The subject invention is advantageously utilized where control of a reactor can be achieved by response to the temperature and pressure of the primary cooling system.

20362 NUCLEAR REACTOR. Calvin R. Breden and Joseph R. Dietrich (to U. S. Atomic Energy Commission). U. S. Patent 2,989,454. June 20, 1961.

A water-soluble non-volatile poison may be introduced into a reactor to nullify excess reactivity. The poison is removed by passing a side stream of the water containing the soluble poison to an evaporation chamber. The vapor phase is returned to the reactor to decrease the concentration of soluble poison and the liquid phase is returned to increase the concentration of soluble poison.

20363 NUCLEAR REACTOR ELEMENT. Manuel C. Sanz and Charles N. Scully (to U. S. Atomic Energy Commission). U. S. Patent 2,990,351. June 27, 1961.

The patented fuel element is a hexagonal graphite body having an axial channel therethrough. The graphite is impregnated with uranium which is concentrated near the axial channel. Layers of tantalum nitride and tantalum carbide are disposed on the surface of the body confronting the channel.

20364 METAL SHEATHED BODIES. Harold Montague Finniston, Leslie Mark Wyatt, and Oliver Sidney Plail (to U. S. Atomic Energy Commission). U. S. Patent 2,990,352. June 27, 1961.

An aluminum-cased uranium fuel element is patented for use in nuclear reactors. A layer of a substance such as graphite or a metallic film, preferably of relatively low thermal-neutron capture cross section, between the uranium and aluminum prevents their interdiffusion.

20365 MEANS FOR CONTROLLING REACTIONS. Lothar W. Nordheim and Eugene P. Wigner (to U. S. Atomic Energy Commission). U. S. Patent 2,990,355. June 27, 1961.

The patented means is described for controlling a nuclear reactor which comprises a tank containing a dispersion of a thermally fissionable material in a liquid moderator and a material convertible to a thermally fissionable material in a container disposed about the tank. The control means comprises a control rod chamber, containing only a liquid moderator, disposed within the container and adjacent to the tank and a control rod designed to be inserted into the chamber.

20366 CONTROL ROD DRIVE. R. A. Chapellier and I. Rogers (to U. S. Atomic Energy Commission). U. S. Patent 2,990,356. June 27, 1961.

Accurate and controlled drive for the control rod is from an electric motor. A hydraulic arrangement is provided to balance a piston against which a control rod is urged by the application of fluid pressure. The electric motor drive of the control rod for normal operation is made through the aforementioned piston. In the event scramming is required, the fluid pressure urging the control rod against the piston is relieved and an opposite fluid pressure is applied. The lack of mechanical connection between the electric motor and control rod facilitates the scramming operation.

20367 METHOD AND APPARATUS FOR CONTROLLING NEUTRON DENSITY. Eugene P. Wigner, Gale J. Young, and Alvin M. Weinberg (to U. S. Atomic Energy Commission). U. S. Patent 2,990,357. June 27, 1961.

A neutronic reactor comprising a moderator containing uniformly sized and spaced channels and uniformly dimensioned fuel elements is patented. The fuel elements have a fissionable core and an aluminum jacket. The cores and the jackets of the fuel elements in the central channels of the reactor are respectively thinner and thicker than the cores and jackets of the fuel elements in the remainder of the reactor, producing a flattened flux.

20368 CONTROL MEANS FOR REACTOR. John H. Manley (to U. S. Atomic Energy Commission). U. S. Patent 2,990,358. June 27, 1961.

An apparatus for controlling a nuclear reactor includes a tank just below the reactor, tubes extending from the tank into the reactor, and a thermally expansible liquid neutron absorbent material in the tank. The liquid in the tank is exposed to a beam of neutrons from the reactor which heats the liquid causing it to expand into the reactor when the neutron flux in the reactor rises above a predetermined danger point. Boron triamine may be used for this purpose.

20369 FUEL ELEMENT SUPPORT. Walter L. Wyman (to U. S. Atomic Energy Commission). U. S. Patent 2,990,359. June 27, 1961.

The described cylindrical fuel element has longitudinally spaced sets of short longitudinal ribs circumferentially spaced from one another. The ribs support the fuel element in a coolant tube so that there is an annular space for coolant flow between the fuel element and the interior of the coolant tube. If the fuel element grows as a result of reactor operation, the circumferential distribution of the ribs maintains the uniformity of the annular space between the coolant tube and the fuel element, and the collapsibility of the ribs prevents the fuel element from becoming jammed in the coolant tube.

20370 NEUTRONIC REACTOR CONTROL ROD AND METHOD OF FABRICATION. S. W. Porembka, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,990,360. June 27, 1961.

A reactor control rod formed from a compacted powder dispersion is patented. The rod consists of titanium sheathed with a cladding alloy. The cladding alloy contains 1.3% to 1.6% by weight of tin, 0.07% to 0.12% by weight of chromium, 0.04% to 0.08% by weight of nickel, 0.09% to 0.16% by weight of iron, carbon not exceeding 0.05%, less than 0.5% by weight of incidental impurities, and the balance zirconium.

Power Reactors

20371 (AE-38) KINETICS OF PRESSURIZED WATER REACTORS WITH HOT OR COLD MODERATORS. O. Norinder (Aktiebolaget Atomenergi, Stockholm). Mar. 1960. 24p.

A set of neutron kinetic equations was developed to permit the use of long integration steps during stepwise integration. Thermal relations which describe the transfer of heat from fuel to coolant were derived. The influence upon the kinetic behavior of the reactor of a number of parameters was studied. A comparison of the kinetic properties of the hot and cold moderators is given. (auth)

20372 (AGN-TM-391) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. PECAN—A CYCLE ANALYSIS CODE FOR GAS TURBINE, NUCLEAR OR CONVENTIONAL POWER PLANTS (IBM 704 COMPUTER). S. Luchter, W. J. O'Donnell, and W. C. Reynolds (Aerojet-General Nucleonics, San Ramon, Calif.). Apr. 1961. 64p.

The PECAN cycle analysis code for calculating various thermodynamic cycle data for gas turbine power plants, based on a given set of design parameters is presented. The calculations enable optimization of a specific power plant design to a major requirement such as weight, economy, or output. The code is restricted to the use of a gaseous working fluid within a temperature range of 300°R to 2300°R, but is otherwise general. (auth)

20373 (ANL-6286) CONCEPTUAL DESIGN OF A COUPLED BREEDING SUPERHEATING REACTOR, CBSR. R. Avery, W. V. Dewey, R. Rohde, and B. J. Toppel (Argonne National Lab., Ill.). Mar. 1961. Contract W-31-109-eng-38. 69p.

The conceptual design of the Coupled Breeding Superheating Reactor, CBSR, for achieving a positive breeding gain and for producing 65 Mw of electric power is presented. The design combines a steam-cooled fast region and a nonboiling pressurized light-water-cooled thermal region. The advantage offered by this arrangement as compared with that using a solid moderator in the thermal zone is that, if a power excursion occurs, the water will increase the void content and tend to limit the excursion. The total reactor power is 216 Mwt, of which 163 Mwt is used to superheat steam as it passes through the fast regions of the reactor and 53 Mwt is transferred to the pressurized water. For this power split the fast core is 4% subcritical without the reactivity contribution of the thermal region. A breeding ratio of 1.4 is calculated for an oxide-fueled fast and thermal core and a high-density, metal-fueled radial blanket. The steam throttle conditions produced are 75 atm and 453°C for an average fast-core power density of 500 Mw/l. The original goal of 565°C throttle steam temperature and 1 Mw/l power density was compromised because of the surface temperature limitation of currently available cladding materials. The system does not require a large external power source for producing the steam introduced into the fast core. This is possible through the use of a steam compressor that increases the pressure of a portion of the superheated steam and thus permits its use to generate the required saturated-steam flow rate by vaporizing the feedwater from the steam cycle. The design includes a pressure-balance system that equalizes the static pressure in both the pressurized-water and steam systems. The pressure-balance system provides a means of cooling the steam regions in an emergency by allowing the pressurized water to flash. These features are intended to permit easier startup, operation, and shutdown of the entire system. A summary of the reactor design characteristics is tabulated. (auth)

20374 (ANL-6306) PHYSICS ANALYSIS OF PROPOSALS FOR EBWR CORE 2. R. Avery and C. N. Kelber (Argonne National Lab., Ill.). Apr. 1961. Contract W-31-109-eng-38. 35p.

Two concepts were investigated as possibilities for the next loading of EBWR. One is a light water spiked plutonium recycle system; the second is a conventional uniformly loaded system with the option of different enrichments in two radial zones. It is concluded that the plutonium recycle scheme is not feasible in EBWR at 100 Mw, and recommendation for a two-enrichment loading for various burnups is made. (auth)

20375 (ANL-6355) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT. (Argonne National Lab., Ill.). Apr. 1961. Contract W-31-109-eng-38. 73p.

Progress on reactor programs and in general engineering research and development programs is summarized. Research and development are reported on water-cooled reactors including EBWR and Borax-V, sodium-cooled reactors including ZPR-III, IV, and IX, Juggernaut, and EBR-I and II. Other work included a review of fast reactor technology, and studies on nuclear superheat, thermal and fast reactor safety, and reactor physics. Effort was also devoted to reactor materials and fuels development, heat engineering, separation processes and advanced reactor concepts. (J.R.D.)

20376 (BMI-X-165) EXPERIMENTAL EVALUATION OF REFLECTIVE INSULATION FOR THE EXPERIMENTAL GAS-COOLED REACTOR. Herbert R. Hazard, George W. Pfannebecker, John D. Hummell, Earl J. Schulz, Gale R. Whitacre, and Lawrence J. Flanigan (Battelle Memorial Inst., Columbus, Ohio). Dec. 21, 1960. Contract W-7405-eng-92. 32p.

Apparatus and techniques were developed for evaluation of reflective insulation for use in the EGCR. Resistance of experimental samples to thermal cycling and to rapid decompression was demonstrated, and conductance measurements were carried out in helium at 1050°F over a range of pressures from 3 to 315 psia. Conductance values for specimens 3 in. thick ranged from 1.15 to 1.58 Btu/(ft^2)(hr)(°F) at 1050°F face temperature. (auth)

20377 (CF-60-10-63(Rev.)) PRELIMINARY DESIGN OF A 10-Mw(t) PEBBLE-BED REACTOR EXPERIMENT. A. P. Fraas, R. S. Carlsmith, J. M. Corum, et al. (Oak Ridge National Lab., Tenn.). May 8, 1961. Contract W-7405-eng-26. 262p.

The proposed design is for a reactor which could be operated at a thermal power generation level up to 10 Mw. It has a core diameter of 18 in., a core height of 8 ft, and a 3-ft-thick graphite reflector surrounding the core at the sides and at the ends. The core consists of $1^1/_2$-in.-diam balls containing about the same total concentration of uranium plus thorium as that required for a full-scale reactor, but the proportion of uranium is higher to sustain criticality in the smaller core. The pressure vessel was designed to allow replacement of that portion of the graphite most subject to radiation damage. This graphite is in the form of concentric cylindrical sleeves 2-in. thick which enclose the core and constitute the inner 6 in. of the reflector. The gas system is designed to supply helium at 1000 psi with a core inlet temperature of 550°F and a core outlet temperature of 1250°F. The gas system configuration was chosen to assure removal of afterheat by thermal convection and to provide good cooling of the entire pressure

nvelope so as to maintain its temperature between 550 and 650°F under all conditions of operation. A steam generator designed to deliver steam at 1000°F and 1000 psi is provided to remove heat. Full-pressure containment of the reactor gas is provided. Gas-tight rooms surround all flanged joints in the gas system to minimize dispersal of activity in the event of a leak and during servicing operations. The tentative reactor site chosen for the study to facilitate cost estimates is close to the present Experimental Gas-Cooled Reactor (EGCR) at Oak Ridge, Tennessee, so that advantage can be taken of the road and services provided for the EGCR. The preliminary estimates indicate that the cost of construction of the proposed reactor might be between $8,000,000 and $9,000,000. (auth)

20378 (CF-61-4-100) A REVIEW OF REACTIVITY LIFETIME ANALYSIS FOR CONTINUOUSLY FUELED, SOLID FUEL REACTORS. B. E. Prince (Oak Ridge National Lab., Tenn.). Apr. 10, 1961. 43p.

A review was made of reactivity lifetimes in continuously-fueled reactors, based on simplified calculational methods applicable to large, one-region reactors. Various fuel-management schemes were investigated. For a given fuel-feed enrichment, moving fuel through the reactor countercurrently in adjacent channels (bidirectional fueling) gave a reactivity lifetime equal to that obtained by graded fueling (addition of fresh fuel and removal of spent fuel throughout the reactor, so that the average nuclear composition is spatially uniform). Also, the final exposure in these cases was twice that obtained from uniform-batch type irradiation. Unidirectional fueling and out-in fueling (fuel charged at ends of reactor, discharged at center) gave exposures between 1.5 and 2 times that for the uniform-batch case. Greater than twice the batch exposure was obtained with the in-out fueling method; however, the resulting power density was strongly peaked at the center of the reactor. (auth)

20379 (CF-61-5-2) PRELIMINARY ANALYSIS OF STEAM LOOP FOR EXPERIMENTAL GAS-COOLED REACTOR. J. F. Bailey (Oak Ridge National Lab., Tenn.). May 1, 1961. 33p.

An examination of several steam loop systems indicated that a system employing a turbine-driven-compressor, an open type heat exchanger, a condenser, and a pump should be selected. The comparison of the different systems was based upon: the amounts of cooling, heating, and power required for each; the relative simplicity of the systems; and the availability, complexity, and physical size of the system's components. A steam leak will not produce a dangerous hazard but will permit a chemical reaction to occur between the steam and graphite which could affect as much as 31 lbm of the removable graphite sleeves. (auth)

20380 (DLCS-1290103) REACTOR PROTECTION SYSTEM. CORE I, SEED 2. Section 1. Test Results T-550083. (Duquesne Light Co., Shippingport, Penna). First issue, Apr. 14, 1961. 12p.

A test of the Reactor Protection System was carried out to test its response to input signals simulating voltage loss to the system's magnetic amplifiers, voltage loss to two of four nuclear instrumentation channels, high neutron flux levels, unusual flow conditions, and varying loop status which initiates safety insertions and shutdowns. The response was found to be satisfactory. (D.L.C.)

20381 (DLCS-1290203) REACTOR PROTECTION SYSTEM. CORE I, SEED 2. Test Results (T-550083-C). Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 14, 1961. 7p.

Tests were conducted to determine the time delay between loss of reactor coolant pump power and the tripping of the safety shutdown breaker, and the closing of the pump power timing relay. The results indicated that 323 to 360 msec, and 167 to 230 msec, respectively, were required. (B.O.G.)

20382 (DLCS-1470102) DETERMINATION OF REACTOR COOLANT SYSTEM PRESSURE DROP. CORE I, SEED 1. Test Results T-550129. (Duquesne Light Co., Shippingport, Penna.). First issue, May 16, 1961. 24p.

A test was made on the Shippingport reactor coolant system to determine its pressure drop and flow characteristics. The results indicate that the total pressure drop of the 1A coolant loop was not as great as that predicted for either fast or slow pump speeds, while that for the 1B coolant loop was greater than the predicted values. The calculated flow rates for each of the four loops (1A, 1B, 1C, and 1D) exceeded the predicted flow rates for related pump head. (D.L.C.)

20383 (DLCS-1470104) DETERMINATION OF REACTOR COOLANT SYSTEM PRESSURE DROP. CORE I SEED 1. TEST RESULTS T-550129. (Duquesne Light Co., Shippingport, Penna.). May 16, 1961. Contract [AT-(11-1)-292]. 34p.

Tests were conducted to determine the Shippingport Pressurized Water Reactor coolant system pressure drop and flow characteristics. The characteristics of the coolant system components tested were generally in agreement with the predicted results, on both slow and fast speeds. (auth)

20384 (DLCS-1490208) CONTROL ROD POSITIONS FOR CRITICALITY. CORE I, SEED 1. 5532 EFPH. Section 2. Test Results T-550130. (Duquesne Light Co., Shippingport, Penna.). First issue Oct. 17, 1960. 17p.

The critical control rod bank heights and bank worths were determined for three different control rod configurations in the Shippingport PWR at 520°F and 1800 psig after 5,532 EFPH's of reactor operation. (T.F.H.)

20385 (DLCS-1500301) CALIBRATION AND INTERCOMPARISON OF CONTROL RODS. CORE I, SEED 1. 5532 EFPH. Section 3. Test Results T-550131. (Duquesne Light Co., Shippingport, Penna.). First issue Oct. 28, 1960. 26p.

At the end of Core I, Seed 1 life a comparison of rod bank critical heights and bank worths in the four corners of the reactor showed that fuel depletion of the core was essentially uniform. The small discrepancy present did not effect operating characteristics at the end of Core I, Seed 1 life. With a given number of control rods in bank, criticality is more readily obtained with the bank symmetrical about a corner of the core than with the bank symmetrical on a side. If adequate reactivity is present, any section of the core can be brought critical by the use of selective control rod grouping while the remainder of the core is held subcritical. (auth)

20386 (DLCS-1510105) DETERMINATION OF COEFFICIENTS OF REACTIVITY. CORE I, SEED 1, EFPH 1692.8. Section 1. Test Results T-550132. (Duquesne Light Co., Shippingport, Penna.). First issue, June 18, 1959. Second issue, Apr. 20, 1961. 41p.

The temperature coefficient of reactivity at the plant operating temperature was $-1.92\ \Delta K/\Delta T \times 10^{-4}$, as obtained from the curve of the temperature coefficient plotted as a function of the temperature. (B.O.G.)

20387 (DLCS-1560103) XENON TRANSIENT. CORE I, SEED 1, EFPH 2790.5. Section 1. Test Results T-612081. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 27, 1961. 31p.

A test on the Shippingport PWR was described, whose purposes were to determine if sufficient reactivity was present in the core to override a peak xenon transient, and to obtain data for rod worth calculations. Equilibrium xenon was established at 60 Mw net electrical output for approximately 35 hours prior to shutdown. The flux was then reduced to approximately 100 μμa. The reactor was maintained critical by withdrawing or inserting rods as necessary. Startup rates were measured by a μμ ammeter. The xenon transient was followed in this manner for 60 hours. Override of peak xenon occurred 8 hr 50 min after shutdown. (auth)

20388 (DLCS-1560105) XENON TRANSIENT. CORE 1, SEED 1, EFPH 4947.6. Section 1. Test Results T-612081. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 20, 1961. 24p.

Tests were conducted to determine if sufficient reactivity was in the core to override a peak xenon transient. After 4947.6 EFPH, there was not enough excess reactivity to override the poisoning with all rods fully withdrawn. (B.O.G.)

20389 (DLCS-1560106) XENON TRANSIENT. CORE 1, SEED 1. Test Results T-612081. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 7, 1961. 18p.

A test was conducted to determine if there is sufficient excess reactivity after 5532.3 EFPH for Core 1 Seed 1 to override a Xe transient, and to obtain data for rod worth calculations. The core did not contain enough reactivity to override Xe poisoning during the first 35 hrs after shutdown. As a result, the point at which peak Xe occurred could not be determined. Data on rod worth are included. (J.R.D.)

20390 (DLCS-1560201) XENON TRANSIENT TEST. CORE 1, SEED 2. Test Results T-612081-A. Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 7, 1961. 19p.

The xenon transient induced by a reduction of reactor gross load from 66 to 28 Mw was easily controlled by periodic rod movements, and the reactor response was termed normal. (D.L.C.)

20391 (DLCS-1560303) XENON TRANSIENT TEST. CORE 1, SEED 2. Test Results T-612081. Section 3. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 20, 1961. 28p.

The reactor was operated at full power to obtain equilibrium xenon concentration and then shutdown for $8\frac{1}{2}$ hr to obtain peak xenon concentration. It then was brought to 75 and then 67% of full power; the xenon concentration returned to an equilibrium value ~4 hr after reactor startup. There was no apparent effect on the nuclear instrumentation caused by xenon concentration changes. Values of rod worth were determined, and operating characteristics during the test are given. (D.L.C.)

20392 (DLCS-1580202) CONTROL ROD DRIVE MECHANISM, PRECRITICAL AND INITIAL CRITICAL TESTS. CORE I, SEED 2. Section 2. Test Results T-550010. (Duquesne Light Co., Shippingport, Penna.). First Issue June 6, 1960. 6p.

The control rod drive mechanisms and associated instrumentation in the Shippingport PWR were in satisfactory operating condition. Deficiencies that were observed during the test and subsequently corrected were: no positive indication of movement in rods 11, 82, 62, 53, and 14, as shown on the rod position indicating lights; and the bottom indicator coil for rod 81 was connected improperly. After the deficiencies were corrected, the test was rerun for the rods in question and all operated satisfactorily. (auth)

20393 (DLCS-2160105) VALVE OPERATING SYSTEM PERFORMANCE TEST. CORE 1, SEED 2. Test Results T-641114. (Duquesne Light Co., Shippingport, Penna). First issue, Mar. 14, 1961. 8p.

A test was run on the Shippingport Pressurized Water Reactor on June 15, 1960, to determine whether or not the pressure and water flask volume of the valve operating system are sufficient to meet requirements under both normal and emergency conditions. The system was found to be satisfactory. A two-hour leak test indicated leakage. (D.L.C.)

20394 (DLCS-2340106) RADIATION LEVELS IN THE VICINITY OF THE PURIFICATION DEMINERALIZERS. CORE I, SEED 2, EFPH 761.3. Test Results T-641306. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 13, 1961. 8p.

Tests indicated that the long-lived activity in the 1BD purification demineralizer was 650 mr/hr maximum at mid-section of the vessel at 26 hr after shutdown, compared to 625 mr/hr for previous measurements made at 30 hr after shutdown. (B.O.G.)

20395 (DLCS-2390201) PERIODIC WASTE DISPOSAL SYSTEM MATERIAL BALANCE TEST. CORE I, SEED 2. Section 2. Test Results T-641317. (Duquesne Light Co., Shippingport, Penna.). First issue, [Mar. 17, 1961]. 13p.

A test was made on the Radioactive Waste Disposal (RWD) system to determine the acceptability of procedures used in containing, processing, and disposing the wastes received from the plant during a steady-state operation. The RWD system was found to be adequate and to have 60,000 gallons available at all times in the Surge and Decay tanks for safety injection. (D.L.C.)

20396 (DLCS-3070102) PRIMARY PLANT SELF-ACTIVATED RELIEF VALVE OPERATION. CORE I, SEED 2. Section 1. Test Results T-641100-B. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 13, 1961. 5p.

The operation of self-actuated pressurizer steam relief valve of the Shippingport PWR was tested within a prescribed setting of 2300 ± 50 psig. The valve popped at 2265 psig and reseated at 2190 psig, with a time lapse of 12.9 seconds between popping and reseating. Leak rates before and after popping of the valve were 0.70 gallons/hour and 1.35 gallons/hour, respectively. The valve performed reliably in that it popped within the prescribed setting and reseated with no observable valve chatter or flutter. (auth)

20397 (DLCS-3180101) REFUELING—CORE 1, SEED 1 RADIATION SURVEY OF SCRAM SHAFT ASSEMBLIES. Test Results T-643704. (Duquesne Light Co., Shippingport, Penna.). First issue, July 27, 1960. 8p.

A test was conducted to determine the radiation level of several scram shaft assemblies after their removal from the reactor vessel during Core 1 Seed 1 refueling. Data on radiation levels near the assemblies 75 days after shutdown are given. (J.R.D.)

20398 (DLCS-3200101) RADIATION SURVEY OF BEWI AND ASEWI REFUELING. CORE 1, SEED 1. Test Results T-643709. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 8p.

The radiation survey of the Blanket Exit Water Instrumentation assemblies Core I, Seed 1 was performed on January 15 and 16, 1960, ~100 days after reactor shutdown at 5806 EFPH. The observed radiation levels varied with

ight from 150 to 500 mr/hr; the highest activity was und at the bottom of both support tubes of each of the four ssemblies monitored, which, in operation, would be lo- ated 5 in. above the top of the blanket fuel assembly. The o inner port Blanket Exit Water Instrumentation units nd the two Auxiliary Seed Exit Water Instrumentation ssemblies were not monitored. (D.L.C.)

0399 (DLCS-3250101) FUEL SHIPPING CONTAINER EST. CORE I, SEED 1. Section 1. Test Results T-43717-A. (Duquesne Light Co., Shippingport, Penna.). irst issue, Apr. 24, 1961. 15p.

A test was performed at the Shippingport PWR, whose urpose was to determine the amount of heat the fuel ship- ing container cooling system was capable of removing hile in a state of equilibrium. Studies were also conducted o determine if after four hours of operation, the increase f the internal wall temperature was less than 30°F, and inally, to determine the effects of loss of cooling water rom the fuel shipping container. (auth)

0400 (DLCS-3330101) 1B HEAT EXCHANGER LEAK EST. CORE I, SEED 1, Test Results. (Duquesne Light o., Shippingport, Penna.). First issue, Feb. 3, 1961. econd issue, Apr. 24, 1961. 37p.

Descriptions are given of various procedures used in etermining leaks in the tubes of the 1B heat exchanger. ir pressurization tests determined leakage and leak rate f nine tubes. The leak-location-detector-probe method vas found promising for locating defects along the length f the tube. Results of the probalog, dye-penetrant, and ltrasonic tests proved inconclusive in determining leak ocations. (B.O.G.)

0401 (DLCS-3370101) PERIODIC CALIBRATION OF REACTOR PLANT FLOW INSTRUMENTATION. CORE 1, EED 2. Test Results T-643720. (Duquesne Light Co., hippingport, Penna.). First issue, Apr. 14, 1961. 16p.

Periodic calibration tests were made from March 25 to pril 26, 1960, on the Shippingport Pressurized Water Re- ctor plant flow instrumentation in order to detect and cor- ect any calibration drift. The instrumentation tested in- luded that for coolant loop flow, purification loop flow, and ill pump suction flow. All instrumentation, except the 1A oolant loop flow D/P cell and the fill pump suction flow D/P cell, were calibrated within ±0.5% of the instrument anges. (D.L.C.)

20402 (DLCS-3380101) CALIBRATION OF CORE FLOW INSTRUMENTATION. CORE I, SEED 2. Test Re- sults T-643726. (Duquesne Light Co., Shippingport, Penna.). First issue, May 15, 1961. 44p.

A test was performed on the core flow instrumentation of the Shippingport Pressurized Water Reactor to determine and correct any calibration drift. Core flow, seed flow, and blanket flow differential pressure cells were calibrated in the operating range of 60 to 100% flow. (D.L.C.)

20403 (DLCS-3420101) PERIODIC CALIBRATION OF REACTOR PLANT DIFFERENTIAL PRESSURE INSTRU- MENTATION. CORE I, SEED 2. TEST RESULTS T-643719. (Duquesne Light Co., Shippingport, Penna.). Apr. 24, 1961. Contract [AT-(11-1)-292]. 24p.

Tests were performed on the Shippingport PWR to deter- mine and correct any error in the differential pressure in- strumentation of the reactor coolant pump, the heat ex- changer, or the reactor vessel. Heat exchanger differential pressure instruments for the coolant loops, as well as the reactor vessel differential pressure units, were calibrated within an allowable error of 1% for 0 to 100% of full scale. The differential pressure instruments for the reactor cool- ant pumps were calibrated to within the ±1% allowable er- ror through the normal operating ranges, but were slightly higher than the permissible error in the upper ranges. (auth)

20404 (DLCS-3430101) PERIODIC CALIBRATION OF LEVEL INSTRUMENTATION. CORE 1, SEED 2. Test Results T-643721. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 7, 1961. 37p.

Periodic calibration tests were made on the water-level instrumentation of the Shippingport Pressurized Water Reactor from March 28 to May 4, 1960 in order to detect and correct any calibration drift. All differential pressure cells and associated water level instrumentation trains, ex- cept the valve operating water flask level and the compo- nent cooling water expansion tank level instrumentation, were calibrated within the 1% accuracy required over their normal operating range. When the system pressure was increased to 500 psig and then 2000 psig, there was no indi- cation of leakage from the high-pressure and low-pressure vent plugs of the D/P cells calibrated. (D.L.C.)

20405 (DLCS-3490102) STATION PERFORMANCE AT STEADY STATE LOADS. CORE I, SEED 2. Test Results T-643728. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 23, 1961. 44p.

The performance of the Shippingport Pressurized Water Reactor was studied under steady-state loads. With three loops in service, 500 ± 0.5°F average coolant temperature, and 1800 psia coolant pressure, the gross output was 63.7 Mwe, and the power level was 99.6%. The power distribu- tion in the core was uniform and no flux tilts occurred for any of the steady-state loads. The heat transfer coefficient and heat rate were determined. (D.L.C.)

20406 (DLCS-3500101) FEDAL SYSTEMS (CHECKOUT TEST). CORE 1, SEED 2. Test Results T-643731. Sec- tion 1. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 10p.

A checkout test of the FEDAL system in the Shippingport Pressurized Water Reactor was performed on May 3 and 10, 1960. The results indicate that the rate meter and FEDAL recorders were not calibrated properly and that a new test procedure is needed. (D.L.C.)

20407 (DLCS-3500201) FEDAL SYSTEM OPERATION DURING STATION START-UP. CORE I, SEED 2. Section 2. Test Results T-643734. (Duquesne Light Co., Shipping- port, Penna.). Apr. 17, 1961. 9p.

A test was conducted to determine if failed blanket fuel elements existed in a core location of the PWR that had high levels of delayed neutron emitter activity. The test showed no significant peaks in the activity level of the water sampled from the J-5 blanket assembly monitored during startup. These activity peaks would have indicated a rupture of the tubing in the blanket fuel assembly. (auth)

20408 (DLCS-3550201) STEAM GENERATOR TEST. 1A Loop, Foster Wheeler Steam Generator. CORE I, SEED 2. Section 2. Test Results T-643701. (Duquesne Light Co., Shippingport, Penna.). First issue, May 16, 1961. 81p.

Tests were run on the 1A Foster Wheeler steam genera- tor from July 18 to August 3, 1960, in order to provide op- erating data. Results obtained from steady-state operation at power levels up to 65 Mw and from transient tests in three increments up to 63 Mw are given for downcomer flow, pressure drop, circulation ratio, boiler heat output, and steam purity. (D.L.C.)

20409 (DLCS-3550301) STEAM GENERATOR TEST (1A LOOP, FOSTER-WHEELER STEAM GENERATOR).

CORE 1, SEED 2. Test Results T-643701. Section 3. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 13, 1961. 20p.

A test was made to determine the effect of varying the boiler water level between +5 and −3.0 in. on the downcomer flow rates for the 1A steam generator. The downcomer flow was appreciably reduced when the boiler water level was below +3.5 in., and the flow in the first downcomer at the heat exchanger inlet was less than 25% of its high drum level flow. To prevent reduction of downcomer flow, repair welds of downcomer baffle seals and baffle installation over two downcomers are recommended. (D.L.C.)

20410 (DLCS-3550501) STEAM GENERATOR TEST (1A LOOP FOSTER WHEELER STEAM GENERATOR). CORE I, SEED 2. Section 5. Test Results T-643701. (Duquesne Light Co., Shippingport, Penna.). May 12, 1961. Contract [AT-(11-1)-292]. 32p.

Steam drum modifications at the PWR greatly improved the Number 1 downcomer flow at lower drum levels. The minimum flow of the Number 1 downcomer was 325,000 lb/hr at −5 inches drum level. This compares with approximately 75,000 lb/hr flow rate prior to steam drum modifications. The boiler water conditions did not change significantly with changes in drum level indicating that steam blanketing was not occurring at the hot end of the heat exchanger. (auth)

20411 (DLCS-3560103) REACTOR COOLANT FISSION PRODUCT ACTIVITY. CORE I, SEED 2, EFPH 1125.8. Test Results T-643732. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 7p.

Tests conducted to determine presence of fuel-element failure by radiochemically measuring the I^{131} and I^{133} content in the reactor coolant system during start-up indicated that one or more fuel-element failures had occurred. The activities were observed to increase from 18,000 to 52,300 dpm/ml for I^{131}, and from 8,800 to 33,400 dpm/ml for I^{133} while the power level was increased from zero to 90%. (B.O.G.)

20412 (DLCS-3560104) REACTOR COOLANT FISSION PRODUCT ACTIVITY. CORE 1, SEED 2. Test Results T-643732. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 6, 1961. 8p.

A test was made to determine the presence of failed fuel elements radiochemically in the Shippingport Pressurized Water Reactor by measuring the concentrations of I^{131} and I^{133} in the reactor coolant system during station start-up. The activities, measured at different times during start-up, revealed no significant evidence of a failed fuel element for this performance of the test. (M.C.G.)

20413 (DLCS-3560105) REACTOR COOLANT FISSION PRODUCT ACTIVITY. CORE I, SEED 2, EFPH 8536.6. Test Results T-643732. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 25, 1961. 9p.

Tests were conducted on the Shippingport PWR to determine the presence of burst fuel elements by measuring the I^{131} and I^{133} activities in the reactor coolant system during startup. While the power level at the PWR was increased from 0 to 100%, the I^{131} specific activity rose from 0.662×10^3 to 15.3×10^3 dpm/ml, and the I^{133} activity rose from 3.80×10^3 to 25.5×10^3 dpm/ml. A purification loop considerably reduced the iodine activity. (auth)

20414 (DLCS-3590401) 1D REACTOR COOLANT PUMP STARTING CHARACTERISTICS. CORE I, SEED 2. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 28p.

Tests were conducted, during slow speed starts, to determine the causes of starting failure in the 1D reactor coolant pump during previous operation. Data taken during the tests were considered inadequate for determining the cause of unreliable pump starting. Recommendations are given for revising the tests. (B.O.G.)

20415 (DLCS-3610101) SHIPPINGPORT ATOMIC POWER STATION REACTOR PLANT COOLDOWN AND TEMPERATURE CONTROL SYSTEM. (Duquesne Light Co., Shippingport, Penna.). Nov. 28, 1960. 17p.

The reactor plant cooldown and temperature control system of the Shippingport PWR was tested at 190°F for $4\frac{1}{2}$ hr. Three coolant loops were open to the reactor, but only one coolant pump was running, at slow speed. One pump in the cooldown and temperature control system was operating. Test results were presented, and suggestions were made concerning design of the plant components. (T.F.H.)

20416 (GAMD-2023) MGCR–CARBON DIOXIDE CYCLE STUDIES. D. F. Putnam and I. H. Kabler (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 20, 1958. Contract AT(04-3)-187. 212p. (MGCR-P-177)

The effects of varying reactor outlet temperature, peak cycle pressure, pressure ratio, compressor split, total fraction pressure drop, regeneration, and compressor efficiency on the carbon dioxide cycle efficiency, reactor inlet temperature, reactor inlet volume flow, and cycle weight flow in the Maritime Gas Cooled Reactor were determined. The results are presented in graphical form. (M.C.G.)

20417 (GAMD-2071) A COOLANT MONITORING SYSTEM FOR HTGR. T. G. Dunning (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 28, 1961. Contract AT-(04-3)-314. 14p.

Monitoring systems suggested for HTGR coolant are discussed. One such monitor is the off-system analyzer in which scintillation counters are used. This monitor may be located in an accessible area. Another system is an on-line monitor which uses a collimated detector pointed at a section of the expansion loop. (J.R.D.)

20418 (GAMD-2124) DEFINITION OF INSTANTANEOUS CONVERSION RATIO AND ITS VARIATION DURING THE FIRST 200 DAYS OF THE 40 eMW'S LIFE. S. Jaye and N. F. Wikner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 23, 1961. Contract AT(04-3)-314. 10p.

The effective multiplication constant of the 40 Mwe HTGR during the first few hundred days of operation was examined. In particular, it was demonstrated that the finite half-life of the Pa^{233} and the consequent hold-up in the production of U^{233} causes the effective multiplication to drop at about twice the rate as that prevailing when Pa^{233} approaches its equilibrium concentrations. It was also demonstrated that the conversion ratio was essentially zero, and did not approach values computed from simple considerations until 160 days after start-up. (auth)

20419 (GEAP-3652) MARITIME LOOP IRRADIATION PROGRAM SAVANNAH I FUEL IRRADIATION. Progress Report First and Second Quarters, July 1960–January 1961. I. L. Marburger (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Feb. 13, 1961. Contract AT(04-3)-189. 73p.

The Maritime Loop Irradiation Program was initiated in June, 1960. A Boiling Water Loop at the General Electric Test Reactor was modified to operate as a pressurized water loop. Incorporated in the modification was equipment

r water chemistry analysis and control which could be erated by the loop operators with a minimum of participa- on by chemistry personnel, and crud deposition coupons, nich were secured by removable holders. Modifications the loop proper included installation of a new tempera- re control valve, new ion exchange columns, new sample at exchangers, an aluminum "flux window," which was aced between the facility tube and the reactor pressure ssel to displace the water, and modification to the test sembly hold down rod. Preliminary examinations of test ssemblies and shrouds were performed at Vallecitos and inor modifications were made. One of the test assemblies as used to establish flow versus pressure drop data. As a sult of these and other tests, the test assembly shroud as modified to provide additional bypass flow area. The roud adapts the square test assembly to the round fa- ility tube. After an extensive operational loop shakedown nd instrument calibration, the loop was termed ready for peration. The test assembly (NMSR-GETR #2) was first serted with flux wires and the reactor brought up to low ower to obtain a flux distribution for power output predic- ons. Final insertion of the test element was then made nd the loop was brought up to operating temperature and ressure. Full nuclear loop operation was achieved on utomatic control without incident or a reactor scram. The est assembly was irradiated for 10 days, receiving approx- mately 265 MWD exposure. The test element power level as approximately 78% of that predicted with the facility ube in its innermost position. During shutdown, at the end f this period, the facility tube was repositioned. Several ross checks have subsequently been initiated to check the ower level. Water chemistry was generally held within pecification with the exception of hydrogen, which was nly within specification intermittently. The loop was oper- ted continuously on automatic control and all loop param- ters were held to the desired values. (auth)

20420 (HW-67937) DECONTAMINATION STUDIES FOR HAPO WATER-COOLED REACTOR SYSTEMS: PROGRESS REPORT JANUARY 1, 1960 THROUGH SEPTEMBER 1, 1960. J. A. Ayres, T. F. Demmitt, A. P. Larrick, G. E. Neibaur, L. D. Perrigo, R. B. Richman, and R. D. Weed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 27, 1960. Contract AT(45-1)-1350. 174p.

An intensive decontamination program is being conducted to determine the effectiveness of prospective processes for decontamination of high-temperature, recirculating, water-cooled, and low-temperature, single-pass, water-cooled, nuclear reactor systems. Candidate processes are also being evaluated to determine their corrosion characteristics. Two distinct types of contamination are encountered in nuclear reactors: fission products and uranium dioxide from ruptured fuel elements, and activated corrosion product films on the piping surfaces. The general decontamination procedure involves a hydrogen peroxide solution for uranium dioxide dissolution, an alkaline-permanganate solution for film conditioning, and an acidic solution for film removal. Several variations of this procedure are being evaluated for application in specific situations. Various acidic solutions are being evaluated during these tests. In general, most of the solutions tested were at least reasonably effective decontaminating agents. In some cases the amount of corrosion exceeded the maximum allowable corrosion value. However, in most cases it should be possible to remedy this situation by using different corrosion inhibitors. (auth)

20421 (NAA-SR-Memo-2568) ANALYSIS OF ORGANIC MODERATED REACTOR EXPERIMENT LOW FREQUENCY OSCILLATORY BEHAVIOR. W. W. Scott (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 5, 1958. 23p.

During scheduled stability tests at the Organic Moderated Reactor Experiment, the reactor plant experienced low frequency oscillations at periods ranging from 14 to 45 min. The oscillations were initiated by "step" insertions of reactivity. In all cases the oscillations were rapidly damped by manual operation of the control rods. The initial application of manual or automatic control of either or both the reactor and air blast heat exchanger controls prevented oscillations from occurring. No high frequency oscillations were observed. An explanation of the oscillatory behavior is given. Performance at conditions other than those that existed during the stability tests is predicted. (M.C.G.)

20422 (NAA-SR-Memo-4437) DEFLECTION OF THE LOWER REACTOR VESSEL HEAD WHEN SUBJECTED TO A TRANSIENT TEMPERATURE CHANGE. H. L. Sujata (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 3, 1960. 15p.

The deflection of the lower head of the HNPF reactor vessel when subjected to a transient temperature change was determined by evaluating the general expressions for the deflection of a flat plate. (auth)

20423 (NAA-SR-Memo-5673) THERMAL UTILIZATION MEASUREMENTS WITH U-10 Mo FUEL IN THE HALLAM EXPONENTIAL LATTICES. O. R. Hillig (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 19, 1960. 74p.

A description is given of measurements required to determine the values of thermal utilization for U-10 wt.% Mo fuel elements in hexagonal lattices of three different spacings. The discussion includes a description of the lattice cells, and a graphical representation of the neutron-flux distributions in the cell materials. Epi-cadmium neutron-flux distributions and cadmium ratios for each lattice cell studied are included. (auth)

20424 (NAA-SR-Memo-5674) RESONANCE ESCAPE PROBABILITY AND FAST EFFECT MEASUREMENTS IN THE HALLAM EXPONENTIAL ASSEMBLIES. O. R. Hillig (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 30, 1961. 30p.

The measurements required to determine (r_p), the ratio of the resonance to thermal captures in U^{238} and (r_ϵ), the ratio of U^{238} fissions to the U^{235} fissions are discussed, and the results are presented. These measurements were made in the multi-rod Hallam-type fuel element in three graphite moderated hexagonal subcritical lattices of different lattice spacings. A description of the lattice cells studied, the measuring techniques, the treatment of the data, and the results obtained is included. (auth)

20425 (NAA-SR-Memo-5953) LIQUID SHIELDING EXPERIMENT FOR THE SRE CALANDRIA-CORE CHANGE. L. E. Anderson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 9 1960. 14p.

The feasibility of the entire calandria-core-changing procedure for the Sodium Reactor Experiment was studied on a small scale using Amsco P-1 as liquid shielding in a stainless steel vessel. Tests indicated that those portions of the procedure involving sodium and Amsco P-1 were feasible and that these operations could be performed safely. Evaporation of residual Amsco P-1 in the core tank was accomplished at temperatures of 250 and 325°F. The evaporation mechanism apparently was one of kerosene vapor saturating the inert gas which was then swept out to the condenser. The amount of carbon in the sodium increased from an ini-

tial reference value of 25 to 30 ppm to a value of 175 to 180 ppm during the operations. Carburization effects on sample stainless steel tabs immersed in the sodium led to a 0.006 in. case depth. Difficulty was experienced in keeping the Amsco P-1 vapor out of the main gas system. Fine particles of sodium suspended in the Amsco P-1 were observed in the fluid drained from the core tank. Carbonaceous residue, from the simulated core-change procedure, was not significant. (M.C.G.)

20426 (NAA-SR-Memo-5989) ANALYSIS OF TRANSIENT THERMAL BEHAVIOR OF UO_2 EXPERIMENTAL FUEL ELEMENTS IN THE SRE, AFTER LOSS OF PUMP POWER. R. P. Varnes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 27, 1960. 73p.

Transient thermal gradients in the SRE core due to incompatibility between the afterscram braked flow of the SRE and the UO_2 fuel test elements were investigated. The analysis showed that the UO_2 fuel elements could not be irradiated at their maximum power density without exceeding the limits for transient thermal gradients between UO_2 fuel test element channels and uranium metal fuel SRE element channels. An experimental scram of the SRE verified these results for the 19-rod cluster type element. The investigation was concentrated on the region of the core containing the UO_2 test elements as a result of the assumption that the steady state relationship between core pressure drop and reactor flow was valid during flow coastdown. Distributed spatial parameter effects were approximated by the "lumped"-parameter model and incorporated in sets of coupled finite difference equations which were then solved by use of a general purpose d-c analog computer. The transient flow in the test elements was computed from the SRE quasi-steady state pressure drop as a function of time. The higher sodium outlet temperature in the UO_2 test element channels resulted in an elevation head, or buoyant force, greater than the elevation head in an SRE channel. This non-linear buoyant force could not be neglected because it significantly increased the transient flow in the UO_2 fuel element and stabilized the channel outlet temperature. (auth)

20427 (NP-10094) APPLICATION TO U. S. ATOMIC ENERGY COMMISSION FOR REACTOR CONSTRUCTION PERMIT AND OPERATING LICENSE. FINAL SAFEGUARDS REPORT. (Saxton Nuclear Experimental Corp., Reading, Penna.). [1961]. 324p.

Design specifications are presented for a 20 Mw(t) power reactor facility to be constructed at Saxton, Penna. Descriptions are given of the characteristics of the facility, operations, and site, the research and development program, and accident and hazards analyses. The fuel in the water-cooled and -moderated core is contained in 1572 fuel rods. Each rod consists of 50-UO_2 pellets in a stainless steel tube, and grouped into 21-fuel assemblies of the spring clip design. (B.O.G.)

20428 (PRDC-TR-43) MONTHLY TECHNICAL REPORT [ON APDA ACTIVITIES], JANUARY 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 20p.

Research and development activities on the Fermi Fast Breeder Reactor are summarized in terms of core design, materials and metallurgy, mechanical handling, electrical and instrumentation systems, liquid metal and steam-systems, and test operations. (B.O.G.)

20429 (SRO-48) MONTHLY PROGRESS REPORT [ON] HEAVY WATER POWER REACTOR PROGRAM, APRIL 1961. (Savannah River Operations Office, AEC). 19p.

Activities in the AEC/AECL cooperative research program are reported. A summary of other research work by DuPont, Nuclear Development Corp., Nuclear Metals Inc., and Sargent and Lundy is also given. Developmental work on the Heavy Water Components Test Reactor is described, and design and development activities related to the Parr Shoals Power Reactor and Florida Power Reactor are outlined. (J.R.D.)

20430 (TID-6237) POWER PLANT DESIGN FOR REMOTE HANDLING. J. E. Brown (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 96p. (XDC-60-7-87)

A guide is presented for designers of power plant components to be used in the development of nuclear aircraft. The problems encountered in remote maintenance are discussed, and hardware and design features that should be incorporated in component designs are specified. (D.L.C.)

20431 (TID-7597) PROCEEDINGS OF THE US/UK MEETING ON THE COMPATIBILITY PROBLEMS OF GAS-COOLED REACTORS HELD AT OAK RIDGE NATIONAL LABORATORY, FEBRUARY 24-26, 1960. (Oak Ridge National Lab., Tenn.). Mar. 3, 1961. 882p.

Issued in two books.

Forty papers presented at the US/UK Meeting on the Compatibility Problems of Gas Cooled Reactors are given. Thirty-two of the papers are covered by separate abstracts. Eight papers were previously abstracted for NSA. (M.C.G.)

20432 (TID-7597(p.291-322)) CARBON TRANSPORT IN GAS-COOLED REACTORS. H. E. Shoemaker (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

An investigation of the transport of carbon by trace impurities in helium was undertaken to determine the feasibility of graphite moderation for the Maritime Gas Cooled Reactor. Niobium and its alloys were not compatible with the low level of impurities for an extended period of time. A reaction took place between the metals and CO to form surface carbides. Oxygen was also absorbed thus seriously embrittling the material. Monel and nickel catalyzed the CO disproportionation to form visible carbon deposits at CO partial pressures approaching 1 atm. Molybdenum had only slight surface carburization and weight change above 1200°F. Type 430 stainless steel showed good resistance to carburization and oxidation below 1300°F and type 316 carburized excessively at 1300 to 1500°F. Monel was the most promising fuel cladding material tested. (M.C.G.)

20433 (TID-7597(p.340-58)) MEASUREMENT OF THE OXIDATION RATES OF B.E.P.O. GRAPHITE. A. R. Anderson, N. K. Taylor, R. J. Waite, and J. Wright (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Oxidation rates of B.E.P.O. graphite were determined in order to predict the heat release due to oxidation of the graphite moderator during temperature excursions accompanying a Wigner energy release. The oxidation rates of the graphite samples were determined by exposing them on silica boats in a temperature-controlled furnace to a stream of air from a compressed air supply. The oxidation rates for the irradiated graphite were considerably greater than those for unirradiated. Some of the enhancement appeared to be possibly due to the irradiation. However, a much greater enhancement was caused by catalysts deposited on the surface of fuel channels. (M.C.G.)

20434 (TID-7602(Pt.I)(p.27-8)) BERYLLIUM OXIDE WORK AT LOS ALAMOS SCIENTIFIC LABORATORY. J. R. Hopkins (Los Alamos Scientific Lab., N. Mex.).

A high-temperature plasma thermocouple reactor using U^{235}-containing cathodes and cesium plasma is described. The materials requirements for using Be metal collectors housed within a long, gas-tight BeO tube in conjunction with the thermocouple reactor are outlined. (D.L.C.)

20435 (TID-11942) PERIODIC REACTOR PLANT LEAK RATE TEST. CORE I, SEED 2. TEST RESULTS T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue Jan. 20, 1961. Contract [AT-(11-1)-292]. 16p.

The cooling system leakage in the Shippingport PWR was measured before and after removal of the relief valve leakage cooler. The relief valve leak rate increased and data became more consistent after cooler removal, indicating that the cooler restricted relief leakage flow. The collection vessel was pressurized with nitrogen for the purpose of breaking a possible vacuum in the relief valve discharge line; the pressurizing had no effect. (T.F.H.)

20436 (TID-12564) NUCLEAR HEAT EXCHANGER ROCKETS. Ralph S. Cooper (Los Alamos Scientific Lab., N. Mex.). [nd]. 18p.

A discussion of nuclear heat exchanger powered rockets is presented in which the nature of such engines is examined. Materials, reactor physics, and propellants are considered from the standpoint of their effects on performance. An overall evaluation of nuclear rockets is included along with problems associated with nuclear radiation. (J.R.D.)

20437 (TID-12754) TITLE 1 DESIGN—EXPERIMENTAL LOW TEMPERATURE PROCESS HEAT REACTOR PROJECT. (Sargent and Lundy, Chicago). Feb. 3, 1960. Contract AT-(11-1)-816. 173p. (SL-1761)

The architectural and engineering criteria for the Experimental Low Temperature Process Heat Reactor are set forth. A description of the plant as proposed, complete with diagrams, heat balance and general arrangement drawings, design and construction schedules, preliminary cost estimates, and outline specifications for the major components of the design is given. The specification prepared to obtain proposals for the furnishing of the reactor and primary system components is also included. (M.C.G.)

20438 (TID-12784) DETERMINATION OF TEMPERATURE COEFFICIENT AT 100% POWER. CORE I, SEED 1. TEST RESULTS (RNI-34a). (Duquesne Light Co., Shippingport, Penna.). Apr. 20, 1961. Contract AT-(11-1)-292. 10p. (DLCS-2980101; DLCS-2980102; DLCS-2980103; DLCS-2980104; DLCS-2980105)

The temperature coefficient of reactivity of the Shippingport PWR is studied over the core lifetime, for operation of the plant at 100% power. This coefficient cannot be determined accurately using the available data because rod worth curves at power are not available. (T.F.H.)

20439 (TID-12785) FEDAL SYSTEM OPERATION DURING STATION STARTUP. CORE I, SEED 2. Section 2. Test Results T-643734. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 17, 1961. 24p. (DLCS-3500203 through DLCS-3500256)

The operation of the FEDAL system during startup of the PWR was described. This system was used to monitor each blanket assembly. Activity bursts indicated failed blanket assemblies at core locations J-5 and K-8. (T.F.H.)

20440 (TID-12786) CORE I CONTROL ROD DRIVE MECHANISM PERIODIC TEST. CORE I SEED 2. TEST RESULTS T-550011. (Duquesne Light Co., Shippingport, Penna.). Apr. 17, 1961. Contract AT(11-1)-292. 20p. (DLCS-1480113; DLCS-1480114)

This test indicated that all of the rod drive mechanisms (except the no. 12 rod drive motor during one run) were operating satisfactorily. There was no appreciable change in the operating characteristics as compared to previous performances of this test. The insulation resistance of all the rod drive mechanisms, stator winding to ground, was over 50 megohms except for the no. 12 rod drive mechanism. The defective stator was replaced with a spare stator that had a satisfactory phase to ground resistance of over 50 megohms. (T.F.H.)

20441 (TID-12803) EXTERNAL RADIATION LEVELS OF REACTOR COOLANT LOOP PIPING AND COMPONENTS. CORE I, SEED 2. Test Results T-612076-A. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 36p. (DLCS-3410102; DLCS-3410103; DLCS-3410104; DLCS-3410105; DLCS-3410106)

Data were obtained on the build-up of corrosion product activity in the Shippingport pressurized water reactor coolant loop piping and components as indicated by external radiation levels. (auth)

20442 (TID-12804) 1D MAIN COOLANT PUMP (ALLIS-CHALMERS NO. 80) INITIAL STARTING AND OPERATIONAL CHECKS. CORE I, SEED 2. Section 1. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 17, 1961. 51p. (DLCS-3590101; DLCS-3590201; DLCS-3590301)

Tests were run to determine the starting and operating characteristics of the Shippingport pressurized water reactor coolant pump under various loop conditions and pump configurations, after modifications and after the pump had been in a hot standby condition. (auth)

20443 (TID-12805) ACTIVATION AND TRANSPORT OF LONG LIVED CORROSION PRODUCTS. CORE I, SEED 2. EFPH 718.7; EFPH 2147.0. Test Results T-641107-A. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 24, 1961. 7p. (DLCS-1980112; DLCS-1980113)

In general the activity levels of the various nuclides Co^{60}, Co^{58}, Hf^{181}, Fe^{59}, Zr^{95}, Mn^{54}, W^{181}, Cr^{51}, increased in the interval between the test performances. This was particularly true of the Fe^{59} and Mn^{54} nuclides where very large increases were noted. Zr^{95} and W^{181} were both undetectable in the two performances. During the interval the system was operated with no purification, and it is likely that the increase in the activity levels of the nuclides of interest is related to the lack of purification. (auth)

20444 (TID-12826) PERIODIC PRIMARY PLANT LEAK RATE TEST. CORE 1, SEED 1. Test Results T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 20, 1961. 13p. (DLCS-2110130; DLCS-2110131)

Tests were carried out to determine the magnitude and location of primary system leakage. The system leak rates were 4.1 and 14.1 gallons per hour for two tests. A relief valve leak rate of 20.6 gallons per hour of primary system fluid existed for the 6 relief valves tested during the first test. All valves appeared to be contributing to the leakage. Similar data obtained during the second test indicated a relief valve leak rate of 0.4 gallons per hour for 7 valves tested, and only one appeared to be leaking. (M.C.G.)

20445 (UCRL-6398) THE PLUTO PROGRAM. Harry L. Reynolds (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 19, 1961. Contract W-7405-eng-48. 24p.

For presentation at the meeting of the American Rocket Society to be held in Gatlinburg, Tennessee, May 1961.

A review of design, operational, and engineering aspects of the Pluto program is presented. Information on the Tory

reactor is included along with a description of the Nevada test site. (J.R.D.)

20446 (UCRL-6428) REALITIES OF LOW-THRUST VS HIGH-THRUST NUCLEAR PROPULSION. Robert H. Fox (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 24, 1961. Contract W-7405-eng-48. 13p.

Advanced propulsion concepts such as ion propulsion or nuclear propulsion are discussed along with the possibilities and problems of application. The discussion embraces current and future research and development problems, a brief comparison of the flight mechanics of high- and low-thrust systems, operational problems, and an assessment of probable areas of superior performance for the low-thrust system. (auth)

20447 (WCAP-4045) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. CVTR PROJECT MONTHLY PROGRESS REPORT FOR OCTOBER 1960. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). 30p.

20448 GAS CIRCULATION IN THE PRIMARY CYCLE OF NUCLEAR POWER STATIONS. Nebojša Gasparović. Brennstoff-Wärme-Kraft, 13: 214-18(May 1961). (In German)

The secondary cycles of gas-cooled nuclear energy plants, which have a gas turbine unit for circulating the cooling medium in the primary cycle, are investigated thermodynamically. The ratio of the heat quantities transferred to the steam cycle in the high and low pressure heat exchangers and the cooling gas temperatures in the reactor determine the choice between a plant with two separate gas streams and one with double heating of the cooling medium in the reactor. (auth)

20449 CIVIL REACTOR DEVELOPMENT IN THE USA. P. Moser (ETH, Institut für Reaktorforschung, Würenlingen, [Switzerland]). Neue Tech., 3: 137-42(Mar. 1961). (In German)

A survey is given of the results of comparative studies of different reactor systems which constitute the USA 10-year program for civilian reactor development. Further, some conclusions concerning the McKinney report are discussed. (auth)

20450 HYDRAULIC STUDIES FOR THE FLUID-BED REACTOR. V. P. Kelly (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng., 10: 40-4(May 1961).

The hydraulics of water-fluidized beds of steel balls up to $^3/_4$ in. in diameter were studied to investigate parameters of bed homogeneity and fluid flow relationships for the fluid-bed nuclear reactor concept. Bed homogeneity was influenced primarily by flow distribution at the bed inlet and static bed depth. Flow rates were correlated successfully with fluidized bed conditions using relationships previously developed for beds of smaller solids. (auth)

20451 STRIPPING REACTIONS OF THE Zr^{90} AND Zr^{91} NUCLEI. N. I. Zaika and O. F. Nements (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1019-21(Apr. 1961). (In Russian)

The values of the transferred angular momenta, parities and possible spins of the ground and excited states of the Zr^{90} and Zr^{91} nuclei are determined by comparing the experimental proton angular distributions in stripping reactions with the theory. (auth)

20452 NAVAL REACTOR PROGRAM AND POLARIS MISSILE SYSTEM. HEARING BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, SECOND SESSION ON REVIEW OF PROGRESS IN THE NAVAL REACTOR PROGRAM AND DEVELOPMENTS IN THE POLARIS MISSILE SUBMARINE SYSTEM, APRIL 9, 1960. (United States. Congress Joint Committee on Atomic Energy). 45p.

Information is presented on the development of the Polaris missile system, including deployment, propulsion, communications, range, and economic aspects. The Polaris submarines are discussed; reactor safety and design, present and future demands, harbor safety, and other facets of the submarine program are outlined. Attention is given to hard and soft land launching sites. (T.F.H.)

20453 POWER REACTOR TECHNOLOGY. Technical Progress Review, Vol. 4, No. 2. Walter H. Zinn (General Nuclear Engineering Corp., Dunedin, Fla.). Mar. 1961. 92p. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign).

Information on world fuel resources is given followed by a discussion of remote military power applications. A section on critical and exponential experiments is included and aspects of various heat transfer techniques are discussed. The proceedings of a conference on reactor kinetics are summarized. Sections are also included which contain information on reactor containment, shielding, thermal conductivity of UO_2, reactor design and construction practice, and operating experience at Shippingport, EBWR, and Hallam. Economic aspects of U. S. and Canadian heavy water reactors are presented followed by descriptions of developmental work on supercritical water reactors and organic moderated reactors. (J.R.D.)

20454 TESTPROBE FOR NUCLEAR POWER REACTOR (to Deutsche Babcock & Wilcox). German Patent DAS 1 095 409. Dec. 22, 1960.

A permanent channel is provided through the reactor biological shield and the reactor pressure vessel. Test probes can be inserted and removed without affecting the reactor characteristics. A separate cooling system is also provided. (EURATOM)

20455 METHOD AND APPARATUS FOR PRODUCING POWER. E. O. Wollan (to U. S. Atomic Energy Commission). U. S. Patent 2,990,348. June 27, 1961.

A neutronic reactor comprising two discrete zones; namely, an inner zone containing fissionable material and an outer zone containing fertile material is described. The inner zone is operated at a low temperature and is cooled by pressurized water. The outer zone is operated at a substantially higher temperature and is cooled by steam flashed from the inner zone. The reactor is particularly advantageous in that it produces high temperature steam; yet the materials of construction in the core (inner zone) are not restricted to materials capable of withstanding high temperature operation.

20456 REACTOR. Walter G. Roman (to U. S. Atomic Energy Commission). U. S. Patent 2,990,349. June 27, 1961.

A pressurized water reactor in which automatic control is achieved by varying the average density of the liquid moderator-coolant is patented. Density is controlled by the temperature and power level of the reactor itself. This control can be effected by the use of either plate, pellet, or tubular fuel elements. The fuel elements are disposed between upper and lower coolant plenum chambers and are designed to permit unrestricted coolant flow. The control chamber has an inlet opening communicating with the lower coolant plenum chamber and a restricted vapor vent communicating with the upper coolant plenum chamber. Thus, a variation in temperature of the fuel elements will cause

a variation in the average moderator density in the control chamber which directly affects the power level of the reactor.

20457 NUCLEAR FISSION CHAIN REACTING SYSTEM. Herbert L. Anderson and Harrison S. Brown (to U. S. Atomic Energy Commission). U. S. Patent 2,990,354. June 27, 1961.

The patent describes a reactor consisting of a plurality of tubes passing through a body of heavy water or graphite, a heat exchanger, means for flowing UF_6 through the tubes and the heat exchanger, and means for bleeding off some of the UF_6 and separating plutonium therefrom. A specific suggestion contained is that the amount of the UF_6 outside the reaction unit be a multiple of that within it.

Production Reactors

20458 (CEA-1820) RELEVES DU FLUX NEUTRONIQUE DANS LES REACTEURS G2 ET G3 EN PUISSANCE. (Neutron Flux Determinations in the G2 and G3 Reactors During Operation). C. Boulinier, P. Faurot, M. Sagot, and A. Teste du Bailler (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nuclearies, Saclay). 1961. 38p.

After demonstrating the sensitivity of the distribution of power in a production reactor to a deformation caused by dissymetries of reactivity in the reactor, a description is given of the method of neutron-flux determination devised for the reactors G2 and G3 under working conditions; the detector used is a tungsten or nickel wire, the γ activity is measured with an ionization chamber. Several flux determinations are given to illustrate the sensitivity of the method. (auth)

20459 (ORO-397(Vol.I)) HFIR PROJECT TITLE I PRELIMINARY PROPOSAL. (Singmaster and Breyer, New York). Feb. 1961. For Oak Ridge National Lab. Contract AT(40-1)-2688. S and B Job No. 1546. 490p.

Aspects of design and construction are presented for the High Flux Isotope Reactor (HFIR). The reactor is intended primarily for production of radioisotopes especially those of the transplutonium elements. Detailed descriptions are given and preliminary drawings are included. (J.R.D.)

20460 WINDSCALE. PROBLEMS OF CIVIL CONSTRUCTION AND MAINTENANCE. Stuart Sinclair. London, George Newnes Limited, 1960. 142p.

The civil engineering problems encountered in building the Windscale Production Reactors are presented. Descriptions are given of the site choice and clearance, early construction, pile chimney and effluent pipeline construction, biological shield work, routine maintenance, and supplementary air cooling system aspects of the plant. (T.F.H.)

Research Reactors

20461 (IDO-16617) SPERT PROJECT QUARTERLY TECHNICAL REPORT, JANUARY, FEBRUARY, MARCH 1960. T. R. Wilson, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 31, 1961. Contract AT(10-1)-205. 31p.

SPERT I. A series of experiments relating to the problem of reactor startup from very low initial power was performed with a cold, clean, stainless steel core in the Spert I facility. The intrinsic neutron source level for this core was measured and found to be approximately 500 n/sec. Time delays were observed between the step-wise injection of reactivity at power levels of about 10^{-5} watts and the attainment of a stable period. In some cases these delays, which are attributed in part to the statistical properties of neutron chains, were as long as 2 seconds. In one sourceless startup test, control rods were withdrawn at a rate of 20¢/sec with period and level scram circuits operative. The period circuit scrammed the reactor at a trivial power level before the reactor period became shorter than 50 msec. SPERT II. Construction of the Spert II facility was completed. Initial criticality was achieved in light water with 24, type "B" fuel assemblies containing 24 plates each and 8, 17-plate, control rod assemblies. The total U^{235} mass of this initial core was 4.69 kg. On the basis of differential rod worth data, the critical mass for this configuration was estimated to be 4.6 kg of U^{235}. An operational core loading containing 6.03 kg of U^{235} was found to have an available excess reactivity of about $2 at a temperature of 400°F and about $6.8 at ambient temperature. In anticipation of future transient testing of a core with a central positive void coefficient, a core loading was investigated in which the plate spacing was increased for the central fuel assemblies. The central void coefficient of approximately $+2 \times 10^{-2}$ ¢/cm^3 was measured for this core. SPERT III. In order to obtain power calibration data for the Spert III neutron chambers and to provide information for future use in the analysis of transient data, the neutron flux distribution was measured at ambient temperature in the Spert III operational core by activation of cobalt wires. The average power level during the irradiation was calculated from the measured flux values and combined with the neutron chamber output data to yield approximate calibration factors for each chamber. The results indicate that power levels from 5 w to 20 Gw can be measured with the present arrangement of four chambers. ENGINEERING. The hydraulic characteristics of the type "D" fuel assemblies were investigated. These loose-plate-type assemblies have been designed for use in the Spert IV reactor. The pressure drop as a function of flow was calculated and found to agree very well with the experimental data obtained in the ETR flow test loop. Plate flutter is not excessive with flow rates up to 610 gpm through the assembly and it is concluded that the type "D" assembly will be acceptable hydrodynamically for use in Spert IV. Pressure-flow relationships were calculated as a function of water temperature for type "B" fuel assemblies with 8, 12, and 24 fuel plates. The calculations agree with available experimental data at 85°F for the 24-plate assembly. (auth)

20462 (IDO-16658) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1960. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 15, 1961. Contract AT(10-1)-205. 53p.

Operations Technical Support. The overall reactivity of the ETR Critical Facility was found to be 1% in $\Delta k/k$ greater than that of ETR (previous difference was 0.5%). The ETR fuel loading and rod withdrawal patterns were changed to allow for core changes due to the GEANP 99M7 loop installation. Reactor Physics and Engineering. $\eta(U^{233})/\eta(U^{235})$ measurements show that no essential difference exists in uranium produced in U. K. and in U. S. The long-term reactivity transient in irradiated thorium slugs was studied and found to be due primarily to Pa^{233} decay to U^{233}. The design and operation of the Reactor Kinetics Simulator, an analog computer component, are described. Fabrication techniques for U–Al alloys containing up to 45 wt.% U and irradiation results for U–Al alloys containing up to 32 wt.% U are described. Nuclear Physics. Crystal spectrometer measurements of η for U^{233} and Pu^{239} indicate that the technique of measuring absolute η needs to be improved. A

multilevel fit to the Pu^{241} total cross section data is given. The yield ratio of isomeric states to ground states by neutron activation were measured for Eu^{152}, Se^{81}, Br^{80}, and Ag^{110}. The disintegration rate and conversion coefficients for the .127-kev gamma ray of Cs^{134m} decay were measured, and a new value of 2.4 ± 0.15 b was derived for the thermal neutron cross section of formation of Cs^{134m}. Thermal activation cross sections were measured for Pm^{147} and Pm^{148}. The chromatographic method used in purifying Pu^{241} from Am^{241} is outlined. Alpha and gamma spectra of Pu^{241} are reported. The current status of the program on inelastic scattering of slow neutrons is described. An analytic solution was prepared for neutron scattering in a Woods-Saxon optical model potential. The directional correlation of the 0.910–0.555 Mev gamma-ray cascade in Sm^{148} following the decay of 5.4-day Pm^{148} was measured and its implications for the spins of the nuclear levels discussed. Preliminary measurements of the gamma-ray branching ratio and half life of Ba^{139} are reported. Computer programs were devised to calculate activity levels produced by single neutron capture and to calculate single-crystal coincidence sum spectra for NaI detectors. An automatic recording system was constructed for an underwater wire scanner for scanning irradiated Co–Al wires. Arm angle indicator and programmer circuits were developed for use with a neutron crystal spectrometer. Applied Mathematics Three IBM-650 programs were developed for computing (1) the steady-state temperature distribution in two-dimensional regions, (2) thermal diffusion constants, and (3) fast diffusion constants. (D.L.C.)

20463 (IDO-16665) MATERIALS TESTING REACTOR–ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1960. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 4, 1961. Contract AT(10-1)-205. 71p.

Experimental and calculated results show that flux flattening is accomplished by moving the boron burnable poison in ETR fuel elements from the fuel region to the sideplates. MTR shim rod calibrations were made for Cycle 146-B by distributed poison techniques. Excess reactivities calculated from these calibrations by three definitions give maximum values of from ~13.5 to 15.5%. The Advanced Reactivity Measurement Facility (ARMF) is now supplementing the Reactivity Measurement Facility (RMF) in making reactor physics measurements on small samples. The design aim of the ARMF is to achieve the maximum sensitivity and reproducibility possible with more stable operation and better control than in the RMF. Heat transfer calculations are being made on a thorium slug in the form of a thick-walled tube, which it is proposed to irradiate, instead of the present solid slug, for U^{233} production in the MTR high flux. Experimental techniques are being developed for measuring the 1/E component of neutron flux in several experimental positions of the RMF. Irradiation of a highly enriched 54 wt.% UO_2–Al fuel plate sample to 56% U^{235} burnup produced a reaction (fission damage) zone around the UO_2 particles. Hydraulic tests made on roughened fuel plates indicated roughening as a possible means of increasing the heat transfer rate during forced convection cooling. Analyses of the total cross sections for Pu^{241} and Pa^{231} were essentially completed, and a final report for Pu^{241} was submitted for publication. Measurements of U^{233} eta values using the Mn bath technique with the monochromatic crystal spectrometer neutrons were continued. Experimental results to date are primarily concerned with measurements of the corrections required. Scattering measurements for samples of U^{233} were undertaken on the fast chopper. Various integral cross sections in reactor spectra were undertaken. The 27,000 b capture cross section of Pm^{148} ($T_{1/2}$ = 40.6 d) is of considerable reactor interest as a material produced from fission products at high fuel burnup. Neutron inelastic scattering measurements from methane were completed and compared with theoretical predictions based upon gas models. These measurements served to demonstrate the reliability of the experimental procedures and provided insight and valuable checks upon the theory as applied to a simple case. A previously unreported 3.14 hr isometric level was found in Y^{90} at 0.685 Mev. A program undertaken to determine the spin of the 512 kev level of decay of 2.3 d Np^{239} by use of directional correlation measurements resulted in a preliminary level scheme. Continuing studies on gamma rays from the decay of both Pu^{239} and Pu^{240} resulted in gamma ray energy measurements not previously reported. A new end-window proportional counter was developed with improved geometry that minimizes the positive slope of the voltage plateau. An all-electronic scanning switch was developed to replace an existing 10 pole 100 position motor-driven rotary switch used to translate scaler data into a form usable by computer equipment. A number of new programs and computing techniques for the IBM-650 (and one for the IBM-704) were developed. These include a least squares program for use in calibrating the ARMF regulating rod, a gamma spectrum interpolation scheme for use in generating analyzer response curves, an IBM-704 code for hot channel analysis in SPERT III, a nonlinear least squares program for the IBM-650, a program for use on the IBM-650 to edit input data for the IBM-704 code PDQ, and a comprehensive MTR-ETR pricing and record-keeping program for the irradiations in these reactors. (auth)

20464 (IEA-34) NIVEIS DE RADIACAO OBSERVADOS COM O IEAR-1 OPERANDO EM POTENCIA. (Radiation Levels Observed with the IEAR-1 Operating at Power). Romulo R. Pieroni, Silvio B. Herdade, Wilma S. C. Hehl, and Dirceu Vizeu (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 18p. (CNEN-IEA-8)

The shielding of the IEAR-1, a swimming pool research reactor, is described in detail. The radiation levels reached at various parts of the reactor and reactor building were measured for the first and second loadings. The results are tabulated and discussed. (J.S.R.)

20465 (NP-10103) SYMPOSIUM SUR LES REACTEURS A HAUT FLUX POUR ESSAIS DES MATERIAUX, DU 21 AU 25 SEPTEMBRE 1959. (Symposium on High Flux Materials Testing Reactors, September 21-25, 1959). (Brussels. Centre d'Étude de l'Énergie Nucléaire). 104p.

The discussions arising from papers delivered during the symposium are presented. The discussions were on the AEC Test Reactor Program, Uses of High Flux Reactors, Design and Uses of High Flux Research and Test Reactors, High Flux Materials Testing and Research Reactor of the Reactor Centrum Nederland, Technological Aspects of the Construction of the Vessel of the BR-2 Reactor, General Electric Test Reactor, Special Design Considerations for High Flexibility in BR-2, Problems Encountered in the Construction of the BR-2 and the Solutions Adopted, Resistance Testing of the Air-Tight Metallic Shell of the BR-2, Analysis of the Methods for the Measurement of the Air-Tightness of Reactor Shells, Operational Safety Considerations for High Flux Testing Reactors, Management Aspects of MTR–ETR Operations, Organization of the BR-2 Section, Some Particular Problems Posed by the Operation of Laboratory Piles, Safety Principles in Instrumentation of Reactors, Regulation and Instrumentation, Electrical Power

Forecasts, and Hydraulic System of Petten Reactor, Utilization of Irradiation Zones Located in the Fuel Element Lattice of Research Reactors, Experimental Facilities of the High Flux Reactor at Petten, Pneumatic Transfer Apparatus for the Irradiation of Samples in a Reactor, Design of Loops for High Flux Reactors, Conception and Testing of Experiments, Power Control, Operating Experience with In-Pile Loops at ORNL, Evaluation and Measurement of Neutron Flux Received by Fuel Samples Irradiated in a Loop Cooled with Dowtherm, Measurement of Nuclear Characteristics of the Experiments, Flux Depressions in Loops and Rigs, and Experimental Measurement of the Activation of Various Types of Steel for Reactor Vessels. (J.S.R.)

20466 THE ASTRA REACTOR. H. Bildstein (Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna), H. Bruneder, A. Burtscher, H. Kratschmann, W. Koenne, and A. Nedelik. Atompraxis, 7: No. 2, 45-51 (Feb. 1961). (In German)

The ASTRA Reactor, a tank reactor, has MTR-type fuel elements of Al–U alloy with 90% enrichment. The water is purified by ion exchange. The experimental facilities of the reactor are briefly described. The reactor construction and assembly are discussed. Core physics is then briefly reviewed, and the data of the first critical experiments are given. (J.S.R.)

20467 THE HOT CELLS OF THE MUNICH RESEARCH REACTOR. Gerhard Weber, August Wieser, Karl-Erwin Betzler. Kerntechnik, 3: 154-7(Apr. 1961). (In German)

The spatial arrangement of the hot cells is given. The procedure for concreting the cells and storage rooms is described in some detail. The installation of the hot cells and storage rooms are sketched. (tr-auth)

20468 LOOP EXPERIMENTS OF THE RESEARCH REACTOR. L. Dolle. Kerntechnik, 3: 158-64(Apr. 1961). (In German)

In the development of high flux reactors and nuclear power plants, the investigation of nuclear fuel materials and reactor construction materials under reactor conditions is necessary. Engineering and operational conditions can be obtained only with the help of loop experiments. The development of loop techniques has assumed in the large nuclear establishments a significant range. The principles for the development, construction, and operation of such experiments are explained. (tr-auth)

WASTE DISPOSAL AND PROCESSING

20469 (HW-69292) ESTIMATES OF DEPOSITION OF MATTER FROM A CONTINUOUS POINT SOURCE IN A STABLE ATMOSPHERE. C. L. Simpson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 20, 1961. Contract AT(45-1)-1350. 27p.

An investigation was made of deposition of matter from a continuous point source in a stable atmosphere. The experimental grid consisted of an elaborately sampled sector extending some 90 degrees in the azimuth and to 25,600 m from the source. A plume of zinc sulfide particles was generated from a ground source near the Hanford Tower for ½ hr during stable nighttime conditions. Air samples were obtained on the grid throughout the passage of the plume. The observations indicated that deposition of matter can be very great and must be accounted for in the diffusion of particulates. The computations of the exchange coefficients based on the deposition measurements compared favorably with the results obtained by other investigations, adding validity to the values of deposition that were computed. (M.C.G.)

20470 (HW-SA-2016) AEROSOL RESEARCH AT HANFORD AND ENGINEERING APPLICATIONS TO PRODUCTION REACTORS. C. E. Linderoth, H. W. Heacock, and L. C. Schwendiman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 24, 1960. Contract AT(45-1)-1350. 23p.

Presented at a Conference at Harwell, England, on "Aerosol Problems of Nuclear Reactors—Chemical Engineering Aspects," Dec. 7 and 8, 1960.

A summary is presented of the engineering and research programs for studying the release of fission products from irradiated uranium and the behavior of the particulates in conduits. The studies were conducted to provide methods of confining or minimizing possible releases from nonroutine reactor effluents. (B.O.G.)

20471 (IDO-14544) CESIUM REMOVAL FROM ACIDIC RADIOACTIVE WASTE SOLUTIONS. M. W. Wilding (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 14, 1961. Contract AT(10-1)-205. 31p.

Laboratory research was conducted to develop a method for removing cesium from highly acidic, radioactive, aqueous, fuel-reprocessing waste solutions by ion exchange on ammonium phosphomolybdate (APM). The solubility in acidic solutions and the thermal decomposition of APM were studied. Batch-type equilibrium experiments demonstrated the effect on cesium removal of acid concentration, aluminum nitrate concentration, temperature, sodium and potassium ions, concentration of cesium, and contact time. Ion exchange column experiments using APM on a silica gel carrier indicated that cesium was removed effectively from simulated, highly acidic waste solutions by adsorption on an APM-silica gel column, and that one gram of APM could remove more than 99.9% of the cesium from 0.9 liter of synthetic ICPP waste. While other means of adsorbing cesium from aqueous solutions are known, this is believed to be the first successful adsorption from highly acidic solutions. (auth)

20472 (IDO-14545) PLANT TESTS ON THE DECOMPOSITION OF NITROUS OXIDE OVER A HEATED RHODIUM CATALYST. L. T. Lakey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 17, 1961. Contract AT(10-1)-205. 11p.

Plant scale tests were conducted to determine the feasibility of decomposing the nitrous oxide in dissolver off gases with a heated rhodium catalyst. The test results from two fixed bed reactors operating on off gases containing between 14.2 and 19.8 vol.% nitrous oxide show that the nitrous oxide content can be reduced to less than 0.05% with catalyst bed outlet at 1300 to 1500°F and space velocities at 472 to 700 hr^{-1}. Rate constants appear to be comparable to those reported in the literature. Suggestions are made for the design of a permanent installation. (auth)

20473 (IDO-14551) WASTE MANAGEMENT AT THE IDAHO CHEMICAL PROCESSING PLANT. A. L. Ayers and P. Burn (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 5, 1960. Contract AT(10-1)-205. 24p.

Unused uranium from spent, highly enriched reactor fuel elements is recovered at ICPP. The recovered uranium, reduced to a radioactivity level near that of unirradiated uranium, is shipped as a concentrated uranyl nitrate solution. Radioactive barium (RaLa), krypton, and xenon can also be recovered in auxiliary equipment. The plant has a variety of processes so that pure uranium, aluminum, zirconium, or stainless steel clad elements can be handled. In all processes, the fuel elements are dissolved in an appropriate media; and fission products and alloying metals are separated from the uranium in two or more stages of solvent extraction. A block diagram of the processes and their interrelations is included. A plot plan of the ICPP showing major buildings and a perspective drawing of the main process building are also included. Waste management at ICPP is designed to maintain the release of radioactive and chemical wastes to plant environs within the limits established by AEC Health and Safety. The radioactive wastes at ICPP range from short half life fission products from the two-day-old fuel employed in RaLa to liquid wastes with seven or eight years decay. Methods of controlling gases, liquids, and solids are considered. (auth)

20474 (ORNL-3036) A PHENOLIC RESIN ION EXCHANGE PROCESS FOR DECONTAMINATING LOW-RADIOACTIVITY-LEVEL PROCESS WATER WASTES. J. T. Roberts and R. R. Holcomb (Oak Ridge National Lab., Tenn.). June 5, 1961. Contract W-7405-eng-26.

A process was developed on a laboratory scale to decontaminate large volumes of low-radioactivity-level process water wastes having a macrochemical composition not very different from tap water but containing more than the maximum permissible concentration of radioisotopes for unrestricted discharge. The water is adjusted to 0.01 M NaOH (pH slightly under 12), clarified to remove the small amount of solids, and passed through a bed of phenolic cation exchange resin. With typical ORNL waste, when the water is made alkaline, more than half the radioactivity is removed by coprecipitation with the calcium and magnesium already present and most of the remaining radioactivity is removed by the resin. About 99.9% of the Sr^{90} and Cs^{137}, the greatest health hazards, can be removed from 1500 to 2000 volumes of the alkaline water by passage through one volume of phenolic resin (Duolite CS-100 or C-3) on a 3.5 to 7 day cycle. Phenolic resins are much more selective for cesium at high pH than other resins. The resin can be regenerated with 10 volumes of 1 to 5 M HCl, removing 99.9% of the strontium and cesium. The waste regenerant can be evaporated to one-half resin volume of concentrated radioactive

waste to be stored, representing an over-all volume reduction factor of 3000-4000 for the ion exchange and evaporation steps. (auth)

20475 A STUDY ON THE ALUMINUM PHOSPHATE FLOCCULATION AS METHOD OF TREATMENT FOR WEAKLY RADIOACTIVE WASTE WATERS. K. F. Eschle (Institut für Reaktorforschung, Wurenlingen, [Switzerland]). Neue Tech., 3: 151-61(Mar. 1961). (In German)

Aluminum phosphate flocculation was studied as a method for treating low level radioactive waste solutions. For information about settling behavior and sorption capacity, trials with distilled water spiked with Sr^{85} were undertaken, pH, concentration, and ratio of concentration of chemicals being parameters. The most important result is that aluminum phosphate flocculation works best at neutral pH. This might be advantageous, if the effluent from a treatment plant has to supply a drinking water system. It was also observed that a higher ratio of phosphate : aluminum, such as 5 : 1, gives better results. Therefore it is possible to replace partly the relatively expensive aluminum salt by trisodiumphosphate. Also, aluminum phosphate flocculation shows a very good removal of Sr. But the removal efficiency for Cs is low. However, conditioning high-level wastes, which contain aluminum in the inactive and a lot of strontium in the active part, may be visualized, although it would be necessary to repeat the treatment several times for reaching the activity of an intermediate-level waste. Expensive concentration of high-level waste can be avoided. A draft of a low-level waste water treatment plant is also included. (auth)

DEPOSITORIES OF USAEC REPORTS

In Countries Other than the U.S.

ENTINA
uenos Aires, Comisión Nacional de Energía Atómica

TRALIA
anberra, Australian National Library
atherland, New South Wales, Australian Atomic Energy Commission

TRIA
ienna, Zentral Bibliothek der Physikalischen Institute der Universität

GIUM
russels, Centre d'Etudes pour les Applications de l'Energie Nucléaire

ZIL
io de Janeiro, Instituto Brasileiro de Bibliografia e Documentacao

MA
angoon, Union of Burma Applied Research Institute

ADA
amilton, McMaster University
ttawa, National Research Council Library
ancouver, University of British Columbia

LON
olombo, University of Ceylon

LE
antiago, Instituto de Investigaciones Geologicas

NA
sinchu, Formosa, National Tsing Hua University Library

OMBIA
ogota, Instituto De Asontos Nucleares

TA RICA
an Pedro, University of Costa Rica Library

A
avana, Comisión de Energía Nuclear de Cuba

MARK
isö, Danish Atomic Energy Commission

MINICAN REPUBLIC
iudad Trujillo, National Palace

ADOR
uito, Escuela Politécnica Nacional

PT
airo, Atomic Energy Commission

ALVADOR
an Salvador, Universidad de El Salvador, Biblioteca de Energia Nuclear

GLAND
irmingham, Central Library
ristol, Central Library
ingston upon Hull, Central Library
eeds, Central Library
iverpool, Central Library
ondon, Central Library, Acton
ondon, Science Museum Library, South Kensington

ENGLAND (CONT.)
Manchester, Central Library
Newcastle upon Tyne, Central Library
Nottingham, Public Libraries
Sheffield, Central Library

FINLAND
Helsinki, Teknillisen Korkeakoulun Kirjasto

FRANCE
Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay
Paris, Académie des Sciences

GERMANY
Berlin, Hahn-Meitner-Institut für Kernforschung Berlin
Frankfurt/Main, Gmelin-Institut
Munich, Technische Hochschule, Bibliothek

GHANA
Accra, University College of Ghana

GREECE
Athens, Greek Atomic Energy Commission

GUATEMALA
Guatemala, Comisión Nacional de Energía Nuclear

HAITI
Port au Prince, University of Haiti

HONDURAS
Tegucigalpa, Comisión Hondureña de Energía Atómica

ICELAND
Reykjavik, University of Iceland, Atomic Energy Library

INDIA
Bombay, Department of Atomic Energy

INDONESIA
Bandung, Java, Bandung Institute of Technology

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Rehovoth, Israel Atomic Energy Commission

ITALY
Milan, Centro di Studi Nucleari di Ispra del C.N.R.N.
Rome, Comitato Nazionale per le Ricerche Nucleari

JAPAN
Tokyo, Science Section, Diet Library

KOREA
Seoul, Office of Atomic Energy

LEBANON
Beirut, American University

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NORTHERN IRELAND
Belfast, Department of Industrial and Forensic Science

NORWAY
Lillestrom, Institutt för Atomenergi

PAKISTAN
Karachi, Pak. AEC Laboratory

PERU
Lima, Biblioteca Nacional

PHILIPPINE REPUBLIC
Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

PORTUGAL
Lisbon, Junta de Energía Nuclear

REPUBLIC OF THE CONGO
Leopoldville, Université Lovanium

SCOTLAND
Glasgow, Mitchell Library

SPAIN
Madrid, Junta de Energía Nuclear

SWEDEN
Stockholm, Aktiebolaget Atomenergi

SWITZERLAND
Zurich, Institut für Physik, Eidg. Technische Hochschule

THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

TURKEY
Ankara, Turkish Atomic Energy Commission, Atomic Energy Library

UNION OF SOUTH AFRICA
Pretoria, Atomic Energy Board Library, Council for Scientific and Industrial Research

URUGUAY
Montevideo, Comision Nacional de Energia Atomica

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Cientificas

VIET-NAM
Saigon, Office of Atomic Energy

YUGOSLAVIA
Belgrade, Federal Nuclear Energy Commission

In International Agencies

TRIA
ienna, International Atomic Energy Agency

GIUM
russels, La Bibliotheque EURATOM

FRANCE
Paris, European Nuclear Energy Agency, O.E.E.C.

ITALY
Ispra, EURATOM Research Center

SWITZERLAND
Geneva, United Nations Library

UNITED STATES
New York, United Nations Headquarters
Washington, D. C., Inter-American Nuclear Energy Commission